FLIGHT

The AIRCRAFT ENGINEER & AIRSHIPS

First Aero Weekly in the World

Founder and Editor: STANLEY SPOONER

A Journal devoted to the Interests, Practice, and Progress of Aerial Locomotion and Transport

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DIARY OF FORTHCOMING EVENTS

Club Secretaries and others desirous of announcing the dates of important fixtures are invited to send particulars for inclusion in the following list :—

1926

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Mar. 27	R.A.F. *v.* Army, Rugby Match, Twickenham.
Mar. 27	R.A.F. (India) Reunion Dinner.
Mar. 31	Entries close for Schneider Cup Race.
Mar. 31	Royal Aero Club Annual General Meeting.
April 8	Marchese de Pinedo, "A 35,000 Miles Flight," before R.Ae.S.
April 13	Mr. S. H. Evans, A.F.R.Ae.S., M.I.Ae.E. "The Performance of Modern Aircraft—with special reference to the Variable Wing," before Inst.Ae.E.
April 21	Inst.Ae.E. visit to Messrs. D. Napier and Son, Acton.
April 22	Capt. G. T. R. Hill. "The Tailless Aeroplane," before R.Ae.S.
April 29	Lieut.-Col. V. C. Richmond. "Results of Recent Airship Flight Tests," before R.Ae.S.
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The Index for Vol. xvii of "Flight" (January to December, 1925) is now ready, and can be obtained from the Publishers, 36, Great Queen Street, Kingsway, W.C.2. Price 1s. per copy (1s. 1d. post free)

EDITORIAL COMMENT.

FOR weeks past rumour has been busy on the subject of British challengers for the Schneider Cup seaplane race, which is scheduled to take place at Hampton Roads, Virginia, in October next. FLIGHT has purposely refrained from commenting upon these rumours, since it was felt that no good purpose could be served by publishing anything which might make still more complicated the already difficult task of the Royal Aero Club, the Society of British Aircraft Constructors, and the Air Ministry. It has, of course, been known that these three bodies have been in close consultation, and the spreading of rumours was not calculated to help, and might do a good deal of harm. Now, however, an official statement has been made on the subject of British participation in the 1926 Schneider Cup race, and it has thus given opportunity to refer to the subject. An informal conference between the racing committee of the Royal Aero Club and representatives of the press was held on March 23, when the final decision was communicated and explanatory statements made. The text of the official decision not to enter machines for this year's race was as follows :—

The Schneider Cup

"At a meeting held at the Royal Aero Club on March 19, 1926, at which representatives of the Air Ministry, the Royal Aero Club, the Society of British Aircraft Constructors and others interested in the Schneider Cup were present, it was unanimously decided that it was inexpedient for the Royal Aero Club to make a challenge for the Schneider Cup Race this year."

The decision will doubtless be received with general regret, but our readers may rest assured that it was not reached until the problem had been thoroughly discussed, and that nobody regretted the necessity for refraining from entering machines more than did those directly concerned.

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Lack of Time

In order that the reasons for the decision may be fully appreciated, it will be necessary to refer back, briefly, to the earlier history of the Schneider Cup race. When the trophy was first put up by M. Jacques Schneider, a member of the famous French armament firm of that name, it is fairly safe to say that no such speeds and engine powers as reached by modern machines had been contemplated. The earlier Schneider Cup machines were powered with engines of round about 100 h.p., and the machines themselves were not so expensive to build but that aircraft firms, or even private individuals, could afford to enter. Gradually, however, the engine powers employed grew and grew, until something like 700 h.p. has been reached, with every indication that still higher horse-powers will be called for. This has naturally meant not only a vast increase in the cost of engines, but also an equally large increase in the cost of the machines as a whole, and—what is perhaps even more important—the necessity for a much longer period of preparation, not only in the matter of testing machines, engines, airscrews, floats, etc., thoroughly, but also in the preparation of the pilots, the handling of such high-speed machines requiring special training and a great deal of practising.

It is thus seen that from every point of view the Schneider Cup race has become infinitely more difficult than it was in the earlier days—financially, technically, and as regards the human element. To the credit of the United States it must be said that they were the first to realise that the only way of tackling the Schneider Cup problem with any hope of success was to make of it a national affair. This they proceeded to do, and in 1923, when they challenged Great Britain at Cowes, they sent over machines and crews backed by the financial and best technical resources of the United States Government. As all the world knows, the Americans won a decisive victory at Cowes, but what everyone did not realise was that America had changed the nature of the Schneider Cup race from a more or less private sporting affair to putting it on a national basis. The British Government has been slow to follow suit, but last year a beginning was made, by ordering a few machines and permitting their constructors to enter them in the race. This year still greater support had been promised, but the fact remained that if we were to have any hopes of winning the Schneider Cup very strenuous efforts had to be made, and the time for making them was considered to be too short. As a result the decision not to enter. Under the circumstances we feel that this decision was the only one to which those concerned could have come. To have rushed machines through for the race, only to discover at the last minute some unexpected "snag," which would have prevented them from putting up a creditable performance would scarcely be calculated to increase British prestige abroad, and that being so, it is surely more dignified to be perfectly frank in the matter, and to state that we regret that we do not feel that we can undertake the construction of machines in time for October.

While on the subject of the Schneider Cup, it may be stated that the Royal Aero Club proposes, at the next meeting of the Federation Aeronautique Internationale in September, to suggest that in the future the Schneider Cup race (if it be still an existing event) be held, not annually, as in the past, but every other year. The suggestion is a very practical one, as the difficulties of building and testing machines for the race have now become such as to require a much longer period of preparation. Whether the suggestion will meet the views of other nations is, of course somewhat problematical.

This brings us to the question that will naturally be asked, *i.e.*, will there be a race this year? The answer to that rests mainly with America. If no country enters machines, America has a perfect right to claim a "walk-over." She has already once forgone that right—a sporting gesture which this country duly appreciated—and if she should decline to declare "no race" this year, small blame could attach to her. In that case the Cup would become the permanent property of the United States, and the question would then arise whether a new cup should be offered, and if so under similar conditions or under totally different ones.

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The Greater Issues

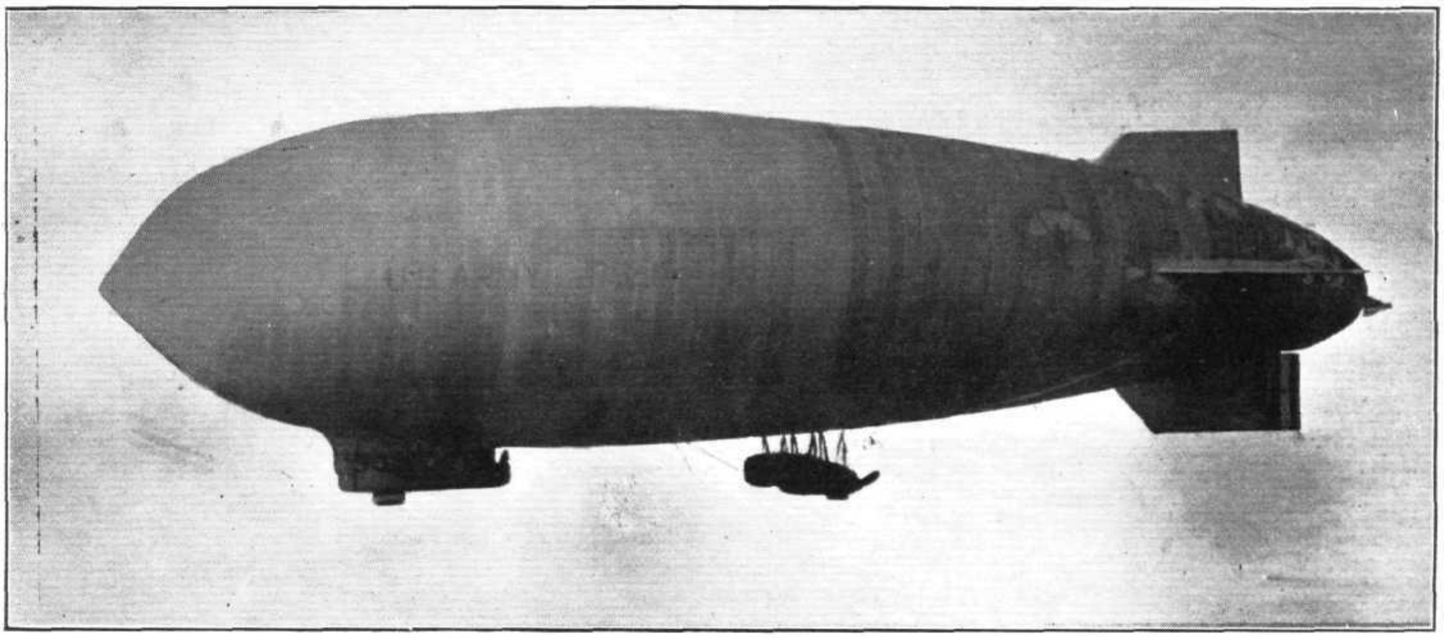
From the fact that it has been decided not to enter machines for this year's Schneider Cup race, it must not be assumed that the development of high-speed machines is to be abandoned. On the contrary, as we have already indicated, Government support for a policy of high-speed development is to be increased, and orders have already been placed by the Air Ministry for several high-speed machines and for new types of engines. These will be completed during the coming summer, and will then be thoroughly tested out, and as a result of the tests further machines will be built, which will be available for the race in 1927, if it be still open. The Air Ministry, now realising the importance of world's records, will not only permit, but will encourage attempts by these machines to establish new world's records, and it is thought that, if successful, the results will be of far greater importance to British aviation than attempting, under the present conditions, to win the Schneider Cup. With which we are cordially in agreement.

This decision is to be welcomed most wholeheartedly, and it is to be hoped that the principle will later be extended to include service machines. It is now several years ago that FLIGHT first pleaded for permission to be given to constructors of service aircraft to let them claim such performances as constituted world's records, performances which certain machines put up as a matter of routine service work. In his paper before the Institution of Aeronautical Engineers, Mr. O. E. Simmonds stated that, with a certain Supermarine flying boat, it would be possible, if permitted, to beat 32 out of the 39 existing world's records, and to put up four new world's records in classes not hitherto successfully attempted. While, therefore, we applaud the decision to go for speed records, we do most certainly ask that constructors be permitted to attempt other records of which certain service machines are capable.

THE GOODYEAR SEMI-RIGID AIRSHIP "RS-1"

The semi-rigid airship "RS-1," built by The Goodyear Tyre and Rubber Co., of Akron, Ohio, for the U.S. Army Air Service, has successfully passed through its recent test flight period, and is now listed for active flying duty at Scott Field army post near St. Louis.

The first American-built semi-rigid airship, it is 282 ft. in length, 70 ft. 6 in. diameter, and has a gas volume of 720,000 cub. ft. Powered with four low-compression Liberty engines in two streamlined power cars located aft and suspended from the keel, the RS-1 develops a total of 1,200 h.p., giving a maximum speed of over 75 m.p.h. under favourable conditions, and a cruising speed of 45 m.p.h., making it the fastest as well as the largest airship in the U.S. Army Air Service.



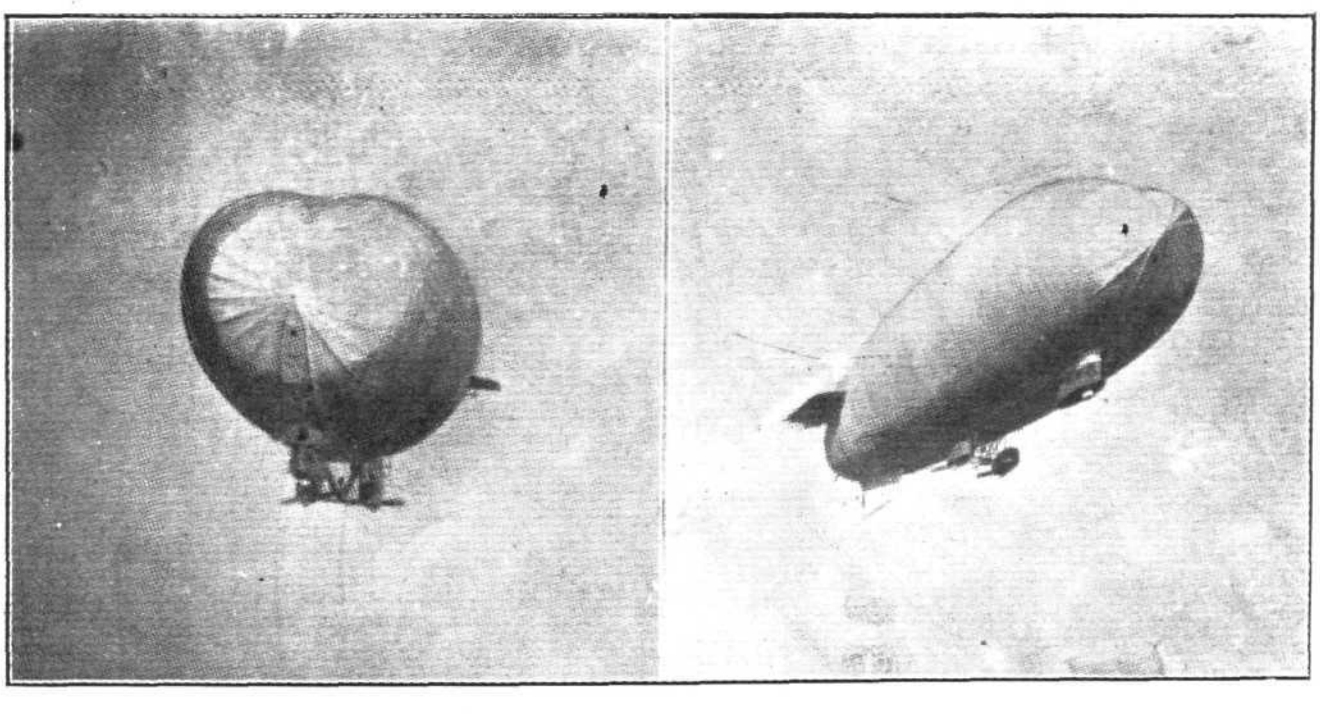
THE GOODYEAR "RS-1" AIRSHIP: This is the first semi-rigid airship to be built in America.

Construction of the parts for the RS-1 commenced in the Goodyear factory at Akron towards the end of 1924, and the parts were then taken to Scott Field for assembly last spring. Although the ship was completed late in 1925, a slight mishap caused by a mistake made by a rigger during erection, prevented trials being carried out until early this year. On its initial trial flight, on January 8, it made a successful trip of over an hour's duration in a mild snowstorm, carrying a crew of eight men and with Lieut. Orval Anderson in charge.

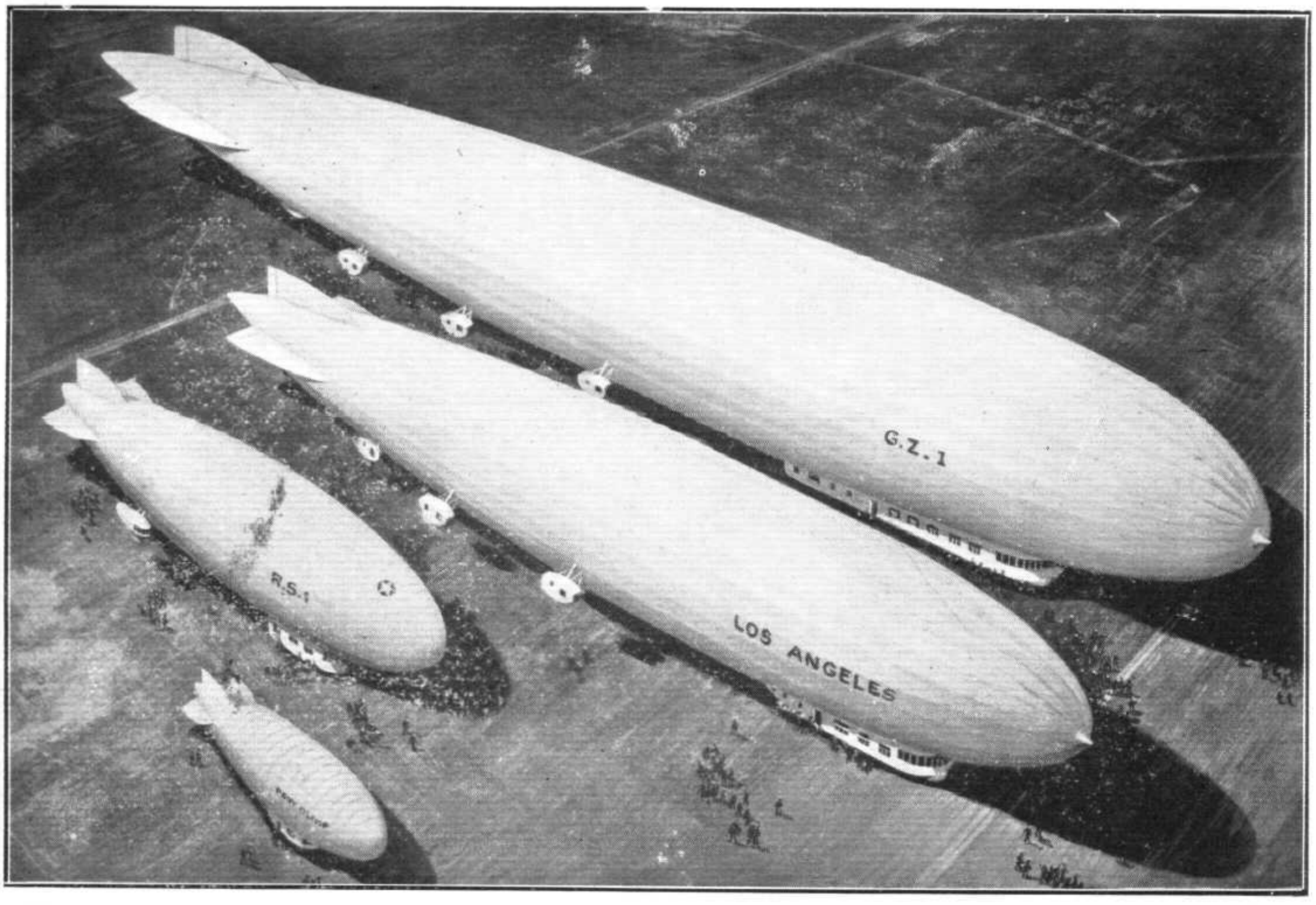
During a subsequent test flight the RS-1 encountered extremely bumpy flying conditions and winds that at times exceeded 50 m.p.h. in velocity. After a flight of 19 hours' duration, however, the RS-1 was landed at its home base in a high ground wind without mishap, the personnel rendering a favourable report of the ship's entire performance.

The RS-1 resembles in many ways the Italian semi-rigid airship N.1, previously described in Flight, although the American ship is slightly larger and is inflated with helium.

Along the belly of the envelope is an enclosed aluminium alloy keel, suspended by catenary cables, which attach to the three points of the keel at 10-ft. intervals. The load coming on the centre catenary gives the envelope a heart-shape transverse cross-section, of which the greatest dimensions are 66·5 ft. by 73 ft. high. The envelope is divided into four compartments by transverse diaphragms. The centre diaphragm is a solid wall, while the end ones have surge holes near the bottom in the gas and air compartments.



THE GOODYEAR "RS-1" AIRSHIP: Two views of the new U.S. Army airship showing the heart-shaped cross-section of the envelope.



SOME GOODYEAR " STEPPING-STONES " : This illustration is intended to show, for comparison, four types of airship, viz :—from left to right, the " Pony Blimp " of 49,500 cub. ft. ; the " RS-1 " described this week, the rigid " Los Angeles " of 2,470,000 cub. ft., and the super rigid G-Z1 (projected).

The air ballonets, with a total capacity of 224,000 cub. ft., are also divided into four by these diaphragms.

The nose of the envelope is provided with 19 duralumin battens secured to the keel extremity, laced to patches on the envelope and supported laterally by five sets of brace wires and two telescopic rings of duralumin tubing. The nose is also provided with mast mooring equipment.

The keel, which forms a great vertebrate spinal column, is constructed of duralumin columns, Phœnix type, of a maximum length of 10 ft. These columns are connected by a ball and socket joint in a forged lynite housing, which housings are part of the rigid transverse triangles. The tension wires of the keel are of streamline form. The fuel, oil, and water ballast tanks, and fore and aft drag ropes are suspended in the keel from the transverse keel frames.

A control car, 35 ft. long and entirely enclosed, is suspended from the keel under the nose of the ship. This car contains the navigating controls, sleeping facilities for officers and men, a motion picture camera and a radio installation.

It is constructed of duralumin framework with fabric and metal sheathing. The control room is separated from the rest of the car by a hollow partition which houses the control cables coming down from the keel. The equipment of the pilot car, in addition to the latest navigating instruments, includes an SCR—135 radio set, a type B-3 camera, bomber's cockpit and equipment, four berths, an auxiliary power-driven 5,000-cub. ft. capacity air blower, map table, &c., &c. The car weighs 1,900 lb., exclusive of radio, camera, and bomb sight.

The armament includes bomb racks of 3,500-lb. capacity and single machine-gun mounts on both sides of the forward end of the pilot car ; a gun mount can easily be arranged for at the extreme bow of the ship, if required.

Owing to the fact that the RS-1 is the first of the semi-rigid type to be built in America, it has been designed to have a high factor of safety, under all conditions, performance being a secondary consideration if it interfered with adequate strength.

It has been designed for training, photographic, and patrol duties, and will later be equipped with a newly designed suspension device to pick up and release a small aeroplane during flight—a development with which the U.S. Army Air Service has experimented for the past three years.

Although considerably smaller than the American rigid airships—the ill-fated " Shenandoah " and the " Los Angeles " —the RS-1 has been designed so that it can be moored to the masts erected for the rigids. It may be mentioned in conclusion that the RS-1, while the first airship of the semi-rigid type constructed in America, belongs to a long line of lighter-than-air craft turned out by the Goodyear Tyre and Rubber Co., which some little while back acquired the patent rights of the German Zeppelin Co. for North America.

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Air Minister's Assistant Private Secretary

THE Air Ministry announces that The Rt. Hon. Sir Samuel Hoare, Bt., C.M.G., M.P., Secretary of State for Air, has appointed Mr. Geoffrey Lloyd to be his Assistant Private Secretary (unpaid).

The African Flights

THE four R.A.F. Fairey IIID biplanes (Napier " Lions ") under Wing-Commander Pulford continued the Cairo–Cape Town flight from Kisumu (Kenya) on March 17 and reached Tabora, via Mwanza. At Tabora they carried out Army co-operation exercises with the 2nd Battalion of the King's African Rifles on March 18, and resumed their journey on March 22, when they flew on to N'Dola. Proceeding the next day, they arrived at Broken Hill, in Northern Rhodesia.

Lieut. Medaets and his two companions, who are flying from Brussels to Kinshasa on a Breguet XIX biplane, reached Mongalla from Atbara on March 17. By March 19 they had got as far as Lisala, in Belgian Congo, and on Sunday morning, March 21, they reached Kinshasa, having thus completed about 5,000 miles in 12 days, or 55 hours' flying time.

Plans for another flight to Cape Town are reported, this time a Swiss effort by Lieut. Mittelholzer (who recently flew from Switzerland to Teheran). This pilot, who will be accompanied by Lieut.-Col. Gouzy, a Swiss journalist, will make the attempt on a seaplane, flying via Athens, Cairo, and Zambesi. The object of the flight is to take films and photographs of wild animal life in the forests of Africa.

LONG-DISTANCE AEROPLANE FLIGHTS*

Mr. Alan J. Cobham, who has just completed a remarkable 17,000-mile flight from London to Cape Town and back, gave a very interesting lecture before the Royal Aeronautical Society last Thursday. Mr. Cobham first apologised for being unable to prepare his lecture, as he had intended, but he had had so little time since he came back—in fact, he had only started on his paper that afternoon.

There were, he said, two main types of long-distance flying. Firstly, long non-stop flights, and, secondly, long flying journeys where many landings were made. The former, so far, had mostly been made purely as stunts or demonstrations of propaganda of some particular type of aircraft. These were very spectacular, and would, he thought, always be a good advertising medium. A few had been made as a commercial proposition, to carry some important dispatches, photographs or special passenger.

The length of a long non-stop flight depended practically on the petrol capacity of the aeroplane, which probably had been increased until the extra weight brought the machine up to its maximum loading. Thus it was up to the designer to work out which was the most economical—a machine that could lift a tremendous load at moderate cruising speed, or the very fast machine which could not carry such a big load. Personally, he thought, the greatest long-distance efficiency came from a machine half-way between these two extremes.

On the question of petrol economy he thought the extra speed gained by opening out the engine in no way paid in distance covered for the extra fuel so used—the greatest distance on a given quantity of fuel could always be obtained by running at approximately two-thirds one's horse-power.

Mr. Cobham then pointed out the great disadvantage to a long non-stop flight, especially for commercial work, owing to the necessity of an enormous petrol reserve that must be carried in order to cope with a head wind. He showed that the weight of such a reserve was far greater in proportion to that required for a short-distance flight.

The question of refuelling, said Mr. Cobham, was purely a matter of organisation, and to-day, even on the best aerodromes, it was hardly possible to land, fill up and get away again in under an hour. He thought the job should not take one quarter of this time, and as proof he quoted the case of the King's Cup Race (1924), where competitors were allowed ten minutes on their handicap for refuelling. Although it was doubted if this could be done in the time, by proper organisation it was actually accomplished within two minutes. If it was possible to refuel in two minutes, what use was there, he asked, in a long non-stop flight?

It would be seen, therefore, proceeded Mr. Cobham, how important a part good ground organisation would play in the development of aviation. The main thing in all flying was speed, so why, having gained hours by flying from one place to another, waste it all again by inefficient service on an aerodrome? He therefore emphasised the importance of revolutionising the existing modes of refuelling. Instead of pouring cans of petrol through a hole in the top of a tank, or pumping, slowly, in 5-gallon measures through the same hole, surely in these days of modern engineering it would be possible, having landed within 20 yards of a given spot, for a flexible pipe to be fitted (by a quick attachment) to a valve at some accessible and convenient point on the aeroplane and petrol under pressure put into the tanks at 50 gallons a minute or more?

The varying changes of weather conditions, said Mr. Cobham, was one of the great difficulties of long non-stop flights, owing to the fact that the great distances covered very often go from one weather zone to another. Therefore unless there was an elaborate system of wireless communication, the machine that landed often would have the advantage of picking up weather reports of conditions ahead.

Another point to be remembered on long non-stop flights was that even for the most hardened it was not good for the passengers—none would do it for pleasure and few out of necessity. It was also very difficult to maintain regularity on a long non-stop flight.

Referring to the effect of long non-stop flights on the pilot, Mr. Cobham said that from his own experience he always noticed that the first half-hour of the flight always seemed the longest. After four or five hours continuous flying, except that he may become a little fidgety he does not usually notice any undue strain and can generally carry on without any desire for food—possibly because he is fed by the oxygen in the pure air in which he flies. In his own longest non-stop flight (London-Madrid) of 9 hours 40 mins. he was quite fresh at the end and able to attend to his refuelling and then carry on for another four hours to Tangier.

He thought the most fatiguing part of flying was worry—worry caused by lack of confidence in the machine and engine and the worry of whether one's destination can be reached on the petrol supply, or the difficulty of finding one's way. As time goes on improved aircraft will banish most of these worries, especially with the development of the three-engined machine. The only other worry the pilot has is that of encountering bad weather. Regarding the subject of navigation, Mr. Cobham stated that the pilot while piloting could never be a real navigator, because while it may not be a mental impossibility to do the two it is a physical impossibility as the pilot only has one pair of hands! He thought, however, that the navigator should most certainly be a pilot, and possibly in the future the stepping stones in the pilot's profession would be second pilot, first pilot, and commander navigator. The commander navigator of the future big air liners would have had years of experience in piloting a machine over a particular air line, and he would be in charge and navigate the liner. The first pilot would no doubt take the aeroplane off the ground and put it on its course in the air, when it will be taken over by the second pilot. On moments of emergency or when sighting the next port the first pilot would take charge.

His own system of navigating was purely one of dead reckoning combined with map reading (using the map to check up drift). A good system was to draw a line on the map between the two points and then take the compass bearing with a protractor. Having allowed for variation and deviation and ascertained magnetic bearing and set the compass accordingly, one set off on the bearing indicated. After the first few miles one located the first landmark on the line—if one passed right over it the course was free from drift, if not one must allow a few degrees (right or left) to compensate this. This was repeated every few miles, but after 20 or 30 miles it was quite simple to find out the correct bearing, allowing for drift, and by carrying on this course it was easy to hit up one's destination by continually checking up the position by the line on the map.

After referring briefly to other matters regarding navigating, Mr. Cobham came to the question of long-distance flights in the nature of aerial tours, from one country to another, or long-distance survey flights across the world. Possibly, he said, these flights were the finest test for both machine and engine that it was possible to have. From his own experience one could fly a machine round an aerodrome for years and really get to know little about it, for it was not until one took that same aeroplane out into the blue across the world that one began to find all its faults and snags.

For general touring work and everyday long distance flights it should be remembered that an engine was required in the early days of aviation that would run on any kind of fuel and lubricant that could be found available. On the other hand when special supplies were laid down these difficulties were eliminated.

In comparing his two recent flights—Rangoon and back, and Cape Town and back—Mr. Cobham said that the outstanding difference between them was the fact that whereas the flight to Rangoon was accomplished on a DH 50 with a 230 h.p. Siddeley "Puma" engine, the flight from London to Cape Town could never have been accomplished with this engine. That was why they had to install extra horse-power in the form of a Siddeley "Jaguar". This was mainly due to the high altitude aerodromes of Central Africa.

Referring to the subject of rarefied atmospheres, Mr. Cobham stated that there were three ways of getting over the difficulty. One was by light loading, the other was by extra horse-power, and the third was by constructing huge aerodromes. Personally, he thought the best course of action was to adopt some of each of the last two—construct a machine with about 35 per cent. more horse-power and an aerodrome double the usual size, a good 1,000 yards square. Mr. Cobham then referred to one or two instances in this connection that occurred during the London-Cape Town flight.

Mr. Cobham stated that he had found on long distance flights when journeying across the world that providing one had sufficient sleep it was possible to keep up, providing also one had no other undue worries, six to eight hundred miles per day, and that after the first few days one settled down to this mode of existence, getting better able to carry on at this rate as one progressed.

* Paper read by Mr. Alan J. Cobham before the Royal Aeronautical Society on March 18, 1926.

Nevertheless, Mr. Cobham gave it as his opinion that world aeroplane routes would have to be run with relays of machines—every 300 miles or so—improved methods of refuelling, previously referred to, making such a system practicable, without loss of time. Furthermore, the passengers would, without doubt, be glad of an opportunity for stretching their legs when changing from one machine to another at each stage.

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Personals

Married

FRANCIS S. S. LAMPREY (Green Howards, seconded to R.A.F.), younger son of A. S. Lamprey, M.A., School House, Ashford, Kent, was married on March 17, at St. Mary Magdalene's, Wandsworth, to AGNES, only child of the late CAPT. DIXON, M.C. (Suffolk Regt.), and of Mrs. DIXON, of Dover.

To be Married

The engagement is announced between HUGH NORMAN DAVIES, R.A.F., son of Mr. and Mrs. Hugh Davies, London, S.W.6, and DOROTHY, elder daughter of Mr. and Mrs. E. F. IEVERS, Croft House, Epsom.

The engagement is announced of OLIVER HUMPHREY CANTRILL, late R.N.A.S., of Dooars, India, eldest son of Mr. E. Crosbee Cantrill (Geological Survey) and Mrs. Cantrill, Ridgecroft, Kidderminster, and MARGARET ISOBEL (Bunny), elder daughter of the late Mr. and Mrs. DAVID BURNETT, of Golden Grove, Carmarthenshire.

The engagement is announced between Flight-Lieut. EDWARD GOODWIN HILTON, D.F.C., A.F.C., R.A.F., son of the late Mr. and Mrs. J. E. Hilton, of Lambourne, Berks, and JOYCE ELIZABETH, younger daughter of Mr. and Mrs. HERBERT J. MARTIN, Mason's Bridge, Hadleigh, Suffolk.

The engagement is announced between Mr. TERENCE HUME LANGRISHE, late Irish Guards and R.A.F., only surviving son of Sir Hercules Langrishe, Bart., and Lady Langrishe, of Knocktopher Abbey, Co. Kilkenny, and Miss JOAN GRIGG, eldest daughter of Maj. Ralph Grigg, late 18th Hus., and Mrs. Grigg, of 42, Hertford Street, Mayfair, London.

The engagement is announced between RICHARD M. THOMAS, R.A.F., of Llanberis House, Moseley, Birmingham, and DOROTHEA WYNDHAM KNATCHBULL, second daughter of Mr. and Mrs. Knatchbull, of the Manor House, Winsley, near Bradford-on-Avon.

The engagement is announced between LEONARD C. LEWIS, late R.A.F., youngest son of Canon F. E. Lewis and the late Mrs. Lewis, and JULIET EVELYN MARY, only daughter of the late Rev. WILFRED ROGERS and MRS. ROGERS, of Tremedden, Falmouth.

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"TOMMY" LYONS

An Appreciation by one who knew him.

IN 1914 the Aeronautics Directorate of the War Office consisted of eight officers and the same number of N.C.O.'s and civilians. The Junior Lieutenant—graded as Staff Captain—had been commissioned from the ranks but three months previously.

In 1917 the Directorate consisted of 168 officers and many N.C.O.'s and civilians, and our lieutenant of 1914 was in charge of the administration, graded as Deputy Assistant Director.

He was whom we later knew as Wing-Commander "Tommy" Lyons, O.B.E., Knight of the Legion of Honour, and also the Order of St. Anne of Russia.

What he had done during those few years was known mostly to himself only. His juniors knew there was "something doing." His seniors only knew that it was done.

He foresaw things in a manner uncanny, and with obstructionists, particularly amateurs—and there were many—T.O.L. was a factor to be reckoned with. It mattered not whether in England or France, a few strokes with his pen on a chit—and, oh, how we who served with him knew those chits—and the difficulties were cleared. A right man had been found by him for a specific job. That man had to be placed in that job. Another was found useless. He was transferred with as little fuss as one changes one's boots.

He had the unique distinction of having been concerned in every department of the Air Ministry and on the formation of that separate body was sole resident officer throughout the hardest days of the war. Thus, after a hard day in the office he would be at the call of everyone through the night from the Secretary of State, to a mother's enquiries regarding a son—from the despatch of a squadron of machines to an application for an extension of leave.

It would take a book to tell all he did, and it is a great pity that he did not live to write that book in his retirement as he intended.

In 1920 he was sent to command No. 4 Stores Depot, Ickenham, the site of which he himself chose in 1916, and here he endeared himself to all with whom he worked and here, after the stress of war, we learned most of what was in the real Tommy Lyons.

He was sent to Iraq in 1921, where, after doing further constructive staff work he was invalided home and after a long spell of sickness followed by a short spell of staff work at Spittlegate, was reposted to his old depot (No. 4) in the autumn of 1923.

His system was control and not interference. He placed the greatest reliance on the integrity of those serving under him and satisfied himself by results and occasional surprise checks.

He had been heard to remark that his depot did not require "commanding." If anything had to be done, he pressed a button and it happened.

Many times, owing to pressure of office work when he had not been able to tour his depot, has he stood at his depot gates on the cessation of work at mid-day or evening (often in heavy rain) with his cheery smile and a recognition for all. It was *his* depot and they were *his* men and how proud he was of them and they of him.

He was taken seriously ill on Friday, January 28, and passed away 20 minutes after his depot had begun work on February 1.

He was buried with full R.A.F. honours in Ickenham Churchyard and, in accordance with his wish, within sight of his depot which he loved so much. No greater visible tribute could have been paid to such a leader as at that sad farewell.

Behind the Service personnel followed in formation of fours the entire staff of the depot—some hundreds of civilians—to the church and grave-side. The whole depot being closed for one hour.

"Tommy" Lyons has gone but his memory lives, and so long as that memory lives and his examples emulated, the R.A.F. shoud be proud that Providence singled out the R.A.F. to be chosen to receive such a man with such an example of loyalty and ability.

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British Empire League and Aviation

SIR HENRY PAGE CROFT, M.P., presided over a meeting of the Imperial Communications Committee of the British Empire League at the House of Commons on March 22, when the following resolution was unanimously adopted: "That this committee notes with satisfaction the recent references of the Minister for Air in regard to Empire communications, and further hopes that immediate steps will be taken to prepare schemes to lay before the Imperial Conference with a view to linking up all parts of the Empire by airship, aeroplane, and seaplane." This was moved by Commander Burney, M.P., and seconded by Sir Harry Brittain, M.P.

The AIRCRAFT ENGINEER

FLIGHT ENGINEERING SECTION

Edited by C. M. POULSEN

March 25, 1926

CONTENTS

OUR CONTRIBUTORS

Dr. Leslie Aitchison will need no introduction to readers of THE AIRCRAFT ENGINEER, his work being already very well known. We are glad to be able to publish this week the first of a series of articles by this distinguished writer on the subject of Duralumin. There can be little doubt that during the next few years more than one firm will turn its attention to Duralumin construction of aircraft, and consequently it is of considerable importance that as much as possible should be known concerning the characteristics, peculiarities, and treatment of this material. In his first article, Dr. Aitchison deals to some extent with the history of the development of Duralumin, but he gives certain information concerning the material after various treatments, and in the article to be published in the April number of THE AIRCRAFT ENGINEER he will refer in more detail to certain technical aspects.

Mr. J. D. North, whose first article appeared last month, continues this week with a further instalment dealing with wing sections in the light of the vortex theory, and next month he will, it is hoped, continue by telling us something about wing proportions, *i.e.*, proceed from the discussion of wings of infinite span to wings of finite span.

Major F. M. Green discusses this week various methods of joining metal parts together, examining such methods of joining as welding, brazing and soldering, and mechanical joints. Although the two former methods have their advantages, Major Green rather favours the mechanical type of joint, in which friction plays an important part, a type of which the firm with which Major Green is associated —Sir W. G. Armstrong-Whitworth Aircraft, Ltd.—has had extensive experience.

Mr. R. J. Mitchell, who is chief engineer and designer to the Super-marine Aviation Works, contributes an article which, if not of a highly technical nature, is of very considerable practical interest, in so far as it deals with the subject of ground operation of flying boats, or in other words with handling trolleys for flying boats. A direct outcome of experience with amphibian gear, the handling trolley is shown to possess many advantages, and to be less likely to damage the hull than is a beaching cradle.

DURALUMIN.

By LESLIE AITCHISON, D.Met., B.Sc., F.I.C., M.I.A.E.

From the time that the production of aeroplanes and airships commenced it has been necessary to employ metals in a greater or less degree—greater in the case of engines, and (in the past) lesser in the structures. In consequence of various circumstances, the use of metals in machines is now very rapidly increasing, and there appears to be some likehood that we have seen the last of wood as a primary material of aeronautical construction. For the purpose of flight, it is obvious that the first thought which will come into the mind of the aircraft engineer about any material is its lightness. Timber has its disadvantages, but it has the supreme merit of being a light material, and one of the earliest problems in metal construction was that of rivalling the wooden structure in weight, whilst preserving the requisite strength and stiffness in the resulting design. This being so, attention was naturally turned to the light metals, and by various reasons this was narrowed down to those deriving from aluminium.

Aluminium in the commercially pure form is an excellent material for certain purposes, but, like most pure metals, it has a very low tensile strength and is too soft to serve many useful engineering purposes. The same things can be said of commercially pure iron or copper, and a large proportion of the whole history of engineering could be written round the developments that have taken place in metallurgy in order to overcome these inherent disadvantages of relatively pure metals. The development of the copper alloys, particularly the brasses and bronzes, took place so far back in the history of metals that one is almost faced with the same problem regarding copper and bronze as to know whether the hen or the egg came first.

With iron the process has been more easy to trace, and, of course, the greatest advances have taken place during the last hundred years—that is, since the manufacture of steel in large masses on a commercial basis became firmly established. The ferrous metallurgist has been adding constantly to the number of useful steels. He has been increasing the hardness or the strength or the toughness, or the capacity to resist the effect of corrosive media, or the capacity to retain at high temperatures a large proportion of strength and hardness properties, impelled forward all the time by the ever-increasing demands of the engineer.

The commercial production of aluminium on a large scale almost synchronised with the period of the most intense development of the alloy steels. At that time there did not appear to be any conspicuous need for aluminium as an

engineering material, and it appeared likely that the metal would be side-tracked into domestic fields and only touch serious engineering in connection with certain branches of electrical work. Even so, it is interesting to note that certain acute minds had already been struck by the possibilities even of aluminium, and some of us remember well the sensation that was caused by the public utterance of Prof. Arnold, one of the staunchest champions of steel, who suggested about 1908 that the age of steel was passing and that of aluminium was commencing. There may be more in this statement than was obvious in 1908, and is even obvious to-day, but it may be surmised with a good deal of certainty that pure aluminium is scarcely the material to bring about the downfall of steel.

Aluminium, although a light metal, is not strong, and for serious engineering purposes is of very little value (excluding those fields in which a high electrical conductivity is of value). If aluminium in its pure state was the only available light metal, the position respecting light metals would be somewhat analogous to that which would occur if alloy steels were entirely unknown and the only known ferrous materials were cast iron and wrought iron. Metallurgical history, of course, repeats itself, and as soon as aluminium became a regular commercial commodity, obtainable in adequate quantities at a reasonable price, strong efforts were made to develop alloys from it which would be able to play the same part in relation to aluminium that the alloy steels play to wrought iron. It is natural that investigations of this kind should have been carried out from many starting points and with a variety of intentions, and we know now that the German Government were very early active in the direction of developing alloys of aluminium for war purposes. In this country, and in most countries, alloys of aluminium with copper and zinc were developed for the manufacture of castings, and certain progress had been attained when the war broke out. The tremendous requirements of aircraft in the Great War resulted in an intensified attack upon the development of these alloys, and during the war the casting alloys were put upon a very sound basis.

Many years before the war, however, Wilm in Germany had been experimenting upon the production of an alloy of aluminium which would be capable of developing a high tensile strength, and, at the same time, be entirely suitable for working into shapes in a way that could not be expected with a casting alloy. In other words, one might say that whilst the cast aluminium alloys were analogous to cast iron, Wilm was endeavouring to develop a material from aluminium that would be analogous to an alloy steel. After a great deal of work, Wilm discovered the very important phenomenon which is now known as age hardening, and as a result of his work, established the fact that certain types of aluminium alloys, particularly those containing magnesium, were susceptible to a process of heat treatment. The development of these alloys did not come all of a sudden, but by the year 1909, or thereabouts, the development had proceeded sufficiently far for the alloy, which has ever since been known as Duralumin, to be fairly definitely standardised as regards composition and treatment. The discovery of Duralumin, of course, was a very considerable achievement, and it is highly significant that although nearly 18 years have elapsed since Wilm's work, no light alloy has since been developed which possesses the same combination of valuable properties, namely a low specific gravity, high tensile strength and adequate ductility, and a capacity for being worked into practically any of the forms in which wrought metals are required, as occur in Duralumin. Various other alloys have been worked upon and developed, but so far, none of them have reached the stage of being technically the competitor of Duralumin. The result is that, whereas the number of cast aluminium alloys is exceedingly great, there is really only one wrought alloy of aluminium that has to be reckoned with seriously.

Duralumin is an alloy of aluminium, and the chemical composition of the material as set forth in the British Engineering Standards Association Specification is as follows:—

Copper	3·5 to 4·5 per cent.
Manganese	0·40 to 0·70 per cent.
Magnesium	0·40 to 0·70 per cent.
Aluminium	the remainder.

It is evident that the material is composed very largely of aluminium, and, as a result, the specific gravity of the alloy is not very far removed from that of the pure metal itself. Pure aluminium has a specific gravity of about 2·70, whilst the specific gravity of Duralumin is about 2·80. This specific gravity of Duralumin makes the alloy conspicuous, even amongst the aluminium alloys, as most of the useful casting alloys have a specific gravity greater than 2·92. Duralumin is never used in the cast state. There is no particular reason, however, why it should not be used as castings if anybody wishes so to use it. The alloy is very particularly a wrought alloy, and it is after working that it responds most readily to those processes of heat-treatment that are employed to develop the high physical properties of the metal. In the cast condition, the material would require a very much longer time of treatment, in order to produce the necessary structural changes which result in the high strength. This, of course, is primarily due to the relative coarseness of the crystalline macro structure of a casting as compared with that of a forged metal, and the time required to bring about diffusion and the like changes in a cast metal is always very much greater than that required by a wrought metal, simply because of the finer structures of the latter material. In the non-heat-treated condition, Duralumin castings are very little superior to castings made in the ordinary aluminium casting alloys. After working and heat-treating there is no comparison whatever between the properties of the two.

When Duralumin has been worked into the various wrought forms, such as sheet, strip, tube, rod, or drop forgings, or wire, it has to be submitted to a process of heat-treatment, in order to develop its optimum properties. Essentially, this process of heat-treatment consists of two stages. The first stage is that of heating the material to a certain definite temperature, at which definite structural changes take place within the alloy. With a view to retaining this "high-temperature" structure as completely as possible, the alloy is then cooled down to atmospheric temperatures as rapidly as possible. In this respect the heat-treatment of Duralumin is exactly similar to that of steel, and the process of heating to a predetermined temperature, followed by rapid cooling, is carried out with Duralumin for the same reasons as apply to steel. The second stage of the operations in the treatment of Duralumin has no obvious counterpart in the treatment of steel. Duralumin after it has been rapidly cooled, is set on one side and allowed to age. After the material has stood for a period of, say, four days, the heat-treatment process can be considered to have come practically to an end, and it is at the conclusion of this period of age-hardening that Duralumin has developed its full mechanical properties. Age hardening in steel does not occur in any comparable manner, and although there may be some similarities in the structural changes which occur during the age-hardening of Duralumin and those which occur in steel, in order to produce the hardness of a quenched material, it is fairly certain that the changes in the ferrous materials take place exceedingly rapidly, and, in fact, mostly occur during the actual period of cooling. In Duralumin the changes occur over a period of time.

The alterations of mechanical properties that are produced in Duralumin by various kinds of heat-treatment can best be illustrated by means of test figures. In the first place, the influence of re-heating to various temperatures should be shown. This can be demonstrated first of all by taking a specimen which has already been subjected to the complete heat-treatment process, and, secondly, by considering a sample that has not been so treated initially but has been annealed, a process which in itself will be considered later. It is desirable to indicate also the different effect of altering the method of cooling from these various high temperatures. Two methods only need be considered, namely, cooling slowly and quenching in cold water. Four series of test values, therefore, are required, namely:—

1. Heat-treated Duralumin re-heated to various temperatures and cooled slowly (*see* Table 1).

2. Heat-treated Duralumin re-heated to various temperatures and quenched in water (*see* Table 2).
3. Annealed Duralumin re-heated to various temperatures and cooled slowly (*see* Table 3).
4. Annealed Duralumin re-heated to various temperatures and quenched in water (*see* Table 4).

The test values obtained from the metal after these various treatments are shown in the following tables. In all cases, the metal was allowed to stand for a week between the treatment and the test.

Table 1.

Reheating Temperature ° C.	Maximum Stress tons/sq. inch.
100	26
200	26
300	19
400	16
450	18
500	19

Table 2.

Reheating Temperature ° C.	Maximum Stress tons/sq. inch.
100	26
200	26
300	19
400	19
450	22
500	26

Table 3.

Reheating Temperature ° C.	Maximum Stress tons/sq. inch.
100	16
200	16
300	16
400	16
450	18
500	19

Table 4.

Reheating Temperature ° C.	Maximum Stress tons/sq. inch.
100	16
200	16
300	16
400	19
450	22
500	26

The values given indicate the nett result produced by both quenching and ageing. To separate these effects, it is necessary to make different tests—after quenching and before ageing—and to compare these with those given above. Actually, it is only necessary to show the results of ageing on the specimens cooled rapidly and a series of values corresponding to the conditions shown in Table 2 and Table 4 are given in Tables 5 and 6, these last two representing the quenched specimens before ageing.

Table 5.

Quenching Temperature ° C.	Maximum Stress tons/sq. inch.
100	26
200	26
300	19
400	16
450	16
500	17

Table 6.

Quenching Temperature ° C.	Maximum Stress tons/sq. inch.
100	16
200	16
300	16
400	16
450	16
500	17

(*To be continued.*)

AIRCRAFT PERFORMANCE.

Wing Sections in the Light of the Vortex Theory.

By J. D. NORTH, F.R.AE.SOC.

(*Continued from p.* 15).

The aeronautical engineer, by the use of experimental data provided by wind channels or by analysis of observations made on aeroplanes in flight, is able to bring the problem of aeroplane performance within the domain of rigid dynamics. To dispense with empiricism and attack problems of this nature by the study of fluid motion has been, and still is, the aim of numerous applied mathematicians. Classical hydrodynamics do not go far in dealing with real problems in actual fluids possessing viscosity and compressibility, and although some progress is being made in this direction the most immediate application of fluid dynamic theory to aeronautics is by the analytical study of motions in an artificial "ideal" medium, incompressible and inviscid. Steady motion of such a fluid can be analysed into that due to a series of sinks and sources together with translational and cyclic motion, just as any series of periodic motions can be more or less approximated as the compounding of series of simple harmonic motions. Even in two-dimensional motion the algebraic analysis is complicated so that it is difficult for the engineer to follow its physical meaning. The graphical synthesis of the elementary motions is, however, easily followed, particularly in simpler cases, and many analogies in elasticity and electromagnetism are easily recognised. Appropriate combinations of sinks and sources with translation motion added give rise to "closed" circuits of stream lines in a stream locally curved and these "closed" circuits may be replaced by a solid body just enveloping them, the external stream lines representing flow past such a body. The term "circuit" has been used to imply closed streamlines analogous to the closed whorls of a finger print, *not* to imply cyclic motion. The streamlines of the elementary systems can be easily constructed (*see* for example Lamb's Hydrodynamics), and the

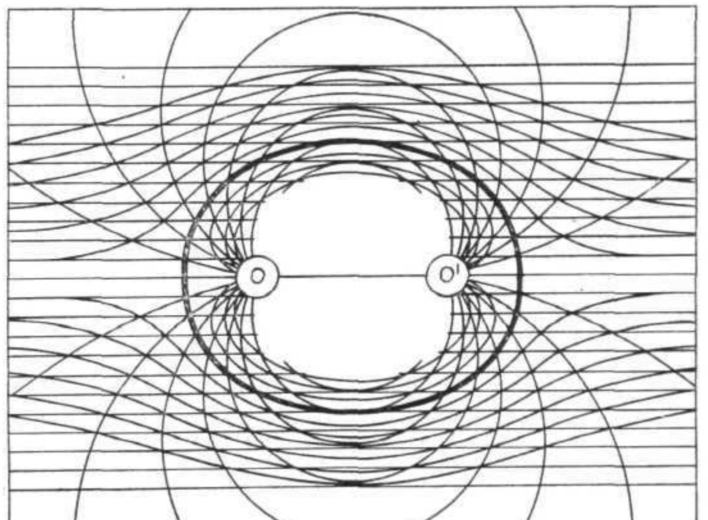


Fig. 3. This figure has been constructed from Fig. 180, page 352, of Bairstow's "Applied Aerodynamics," but the lines have been made symmetrical by repeating them above the line of symmetry.

resulting combined streamlines constructed just as resultant velocities can be graphically determined.

From Bernouilli's equation (*see* Lamb's Hydrodynamics p. 21), it can be shown that the total head at any point of a streamline is constant.

Algebraically,

$$P + \tfrac{1}{2}\rho V^2 = \text{a constant, where}$$

$$P = \text{pressure } \rho = \text{ fluid density } V = \text{velocity.}$$

It will be remembered that we are dealing with an incompressible fluid so that density is independent of pressure. It is plain that this introduces a very important limitation to the possible velocities if flow is to be conformable. By conformable is meant conforming to the shape of the body. As the velocity along the streamline rises, the pressure necessarily falls, and should the velocity rise to such a figure that the pressure to satisfy Bernouilli's equation would have to fall by an amount greater than the initial fluid pressure, an absolute negative pressure would be required to maintain conformable flow. A negative pressure is plainly impossible in an incompressible fluid hence such phenomena as cavitation in water. It will also be obvious that the application of analyses for the "ideal" (*i.e.* incompressible, inviscid) medium will only apply to air if the actual compressibility effects in air are negligible, or in other words, if the pressure changes are only such as to produce a negligible change of density. We shall have to return to this point in a later article in discussing high speed phenomena such as are found with fast running large diameter propellers. For the moment, however, it is sufficient to emphasise the importance of gradual changes of curvature to avoid giving rise to high velocities where there are violent changes of curvature. The potential or pressure system normal to the streamlines can equally be plotted and where the flow is conformable to a body it will be found that the pressures on the body will balance out—the body will be in equilibrium.

If the fluid were viscous (sticky)—capable of giving rise to forces tangential to the surface of the body—the simple introduction of the body for the "closed" circuit streamlines would be impossible. There must now be a finite velocity gradient between the surface of the body and the external streamlines. This boundary layer is known to be extremely thin and to effect a negligible change in the external stream lines around the greater part of the body. An idea of what happens in this boundary layer may be gathered by imagining the layer represented by a thin layer of dough placed between the palms of the two hands. Now, if the hands be moved relatively to one another, *e.g.*, one forwards and the other backwards, the dough will roll up into a number of rollers. I have not tried this experiment, and I cannot guarantee its success in practice; it presents, nevertheless, a good picture of the relative movement of the sticky air and the body rolling up the air in the boundary layer. A somewhat similar phenomenon can be seen in the rollers forming in shoal water due to the friction between the water and the sand. The energy of these rollers has to be accounted for, and the force associated with its production is usually known as skin friction, and one is forced to the conclusion that very little else is known about it. Various expressions based on experiment are extant which purport to assess this form in terms of length and velocity. Velocity in this instance is the mean velocity of the total stream, or alternatively the velocity of the body through still air. The most popular of these is Zahm's. I do not give the form of the expression as it does not appear to me to represent anything but an empirical formula for the actual experimental forms used within a limited velocity range. An infinitely thin lamina is unfortunately not a practicable possibility; consequently, all such experiments are obscured by "form" resistance. Even if it were practicable, so far as I know—and I am quite open to correction—it remains to be demonstrated that an expression containing only the above variables is applicable to any form of body, particularly in the presence of cyclic flow.*

* It is perhaps as well to mention that this somewhat crude attempt at picturing certain aerodynamic phenomena is part of a series of articles on performance and that fuller or more accurate representation would be out of place. Reference should be made to Lanchester's "Aerodynamics" and "The Flying Machine", Proceedings—Institute Automobile Engineers, 1915 (separately published) and particularly to Bairstow's paper "Skin Friction and the subsequent discussion—Journal R. Aë. Soc. January 1925".

When the streamlines meet a body they must diverge, and after passing round the body must meet again. If the condition of continuous curvature is to be maintained it is plain that the divergence and the closure must be cusplike. If the presentation of the body is to be changed under flight conditions (change of incidence), there must be movement of the forward stagnation point. This demands the removal of the forward cusp in favour of a rounded nose of curvature gradually increasing towards the normal stagnation point. Very little can be done with the movement of the aft stagnation point. For obvious reasons, the back cannot be so rounded as to make any appreciable difference to the high velocities in the trailing edge region, the prime cause of the breakdown of conformable flow as change from normal presentation takes place. If we leave the body as it now is, the familiar Joukowsky streamline form will be easily recognised. The cusped rear end is, however, a practical nuisance—in fact, anything but an approximation is almost a practical impossibility. Fortunately, experimental evidence such as the tests on wing forms, airship bodies and the like, indicate that within reason the closure of the trailing part of the body at a finite angle has a negligible effect on the resistance. There are two possible explanations for this: firstly, towards the end of the cusp the pressures are so nearly normal to the stream that their component resistance parallel to the stream is a very small part of the total pressure over this part of the body. A second possible additional explanation is that the cumulative effect of the boundary layer rollers tends to cause the streamlines to break away just before the end of the tail is reached, this region shedding a periodic stream of eddies whose energy is partly (mainly ?) derived from the boundary layer rollers. Pictures of such flow (ref. Bairstow's Applied Aerodynamics, p. 349) shows this phenomenon for bodies with finite trailing edges (Figs. 174 and 175.) I have not seen experimental flow patterns for Joukowsky cusped forms, but if the difference of resistance is negligible, it is hard to believe that similar non-conformable flow and eddy-making would not be present at the tail. As a natural consequence, it would follow that the form of the tail in the non-conforming region was of minor importance, or even that it could be cut off altogether. Some struts which had been so mutilated were included in a series tested at the National Physical Laboratory in 1912, at the instance of Mr. Alec Ogilvie (a full description was published in the issue of FLIGHT, for June 15, 1912). The results were very favourable. Unfortunately, these tests were carried out at fairly low Vl (though Vl = 2·5 is well towards a stable type of flow.) I do not know of any further experiments in this direction, although owing to certain practical advantages I used this form for interplane struts and for fuselages on several machines about this period. The full scale evidence (of course, largely negative and of doubtful qualitative value) did not indicate that at higher values of Vl the favourable resistance coefficient was not realised. In addition, some experiments on aerofoils carried out at the Royal Aircraft Establishment (see R. & M. 928) indicate that blunting the trailing edge of wing sections does not sensibly increase their resistance, whilst a more extensive and systematic series of experiments carried out by Boulton & Paul, Ltd., in their wind channel at Norwich at Vl = 30 seems to show that truncation can be carried to considerable lengths with slight effect on aerodynamic properties. It does not, of course, follow that these suggestions are valid at speeds where compressibility becomes important. Nearly all readers will, I think, understand that the term "bodies," which I have used from time to time in this article does not refer to aeroplane bodies in particular, but to any solid object placed in the stream of flow. I have referred to a change in attitude as affecting the flow round bodies, but made no mention of lift. In fact, the types of flow discussed do not give rise to lift and conformable flow in the "ideal" fluid could not cause lift. It must now be imagined that the figures represent a section of a wing of infinite span and the flow around it. As the span is infinite, every section normal to the span will have the same flow pattern. If we consider a wing section and plot the streamlines in an "ideal" fluid by the sink and source and translational method (the complexity of the actual process may be gathered from Taylor's

paper to the Institute of Naval Architects, quoted on p. 351 of Bairstow's Applied Aerodynamics) the resulting flow is as in Fig. 4 (shown by the full lines AA). Experimentally, also see Fig. 178 in Bairstow's "Applied Aerodynamics," demonstrated by Hele Shaw's flow pattern machine. For a demonstration of this method and references to Stokes' correlation of "super-viscous" and non-viscous flow, see Chapter VII. *ibid.*

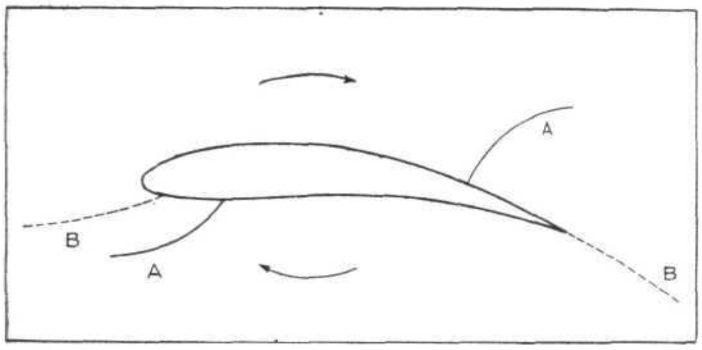


Fig. 4.

The type of flow A A would lead to impossibly high velocities at the leading and trailing edges, and can only be made conformable by moving the stagnation points, as indicated by the dotted lines. This can be achieved by adding cyclic flow in the direction shown by the arrow. By cyclic flow is meant motion round a filament, the velocity being inversely proportional to the distance from the core (the analogy with a sink or source by the interchange of flux and potential may be noted).

The influence of cyclic flow on the flow pattern round a cylinder in a uniformly moving stream can be seen from Figs. 5 and 6, which have been taken from A. R. Low's paper on "The Circulation Theory of Lift," read at the International Air Congress, London, 1923. If the stream is taken to be flowing from left to right the cyclic flow in Fig. 6 is clockwise. Accordingly, the velocity in the stream-lines will be *increased* on the top of the cylinder, *decreased* on the bottom. From Bernouilli's equation the pressure normal to the streamlines will be diminished on the top and increased on the bottom, causing a force in the direction of the arrow (lift). It should be, perhaps, made clear that the terms p and $\frac{1}{2}\rho V^2$ in Bernouilli's equation are the static and dynamic pressures respectively. The static pressure is normal to the streamlines, and the dynamic is the "face" pressure in the streamline. Where the flow past a point is zero, as at the front stagnation-point, the dynamic pressure $\frac{1}{2}\rho V^2$ acts normal to the surface at this point. One may compare the action of the dynamic and static heads of an air-speed indicator.

Everyone will have recognised that we have here the Flettner rotor. The cyclic flow can only be communicated to the fluid by virtue of viscosity, and there will, of course, be a boundary layer with rollers. It can be shown that the compounding of cyclic flow round an infinitely small filament and translational motion gives rise to a force (lift) at right angles to the direction of motion proportional to the strength of the cyclic flow and the velocity. As this force is at right angles to the direction of motion, there is no energy communicated to the stream and *there is no resistance*. The resistance comes from the imperfectly conformable flow and the eddy making, including the boundary layer rollers. The stream-line flow round a cylinder can be determined from a sink-and-source system, and, assuming that the boundary layer is negligibly thin, the whole flow and pressure system can be calculated for any cyclic flow (or circulation, as we may now call it) and any velocity, provided that the flow is approximately conformable.

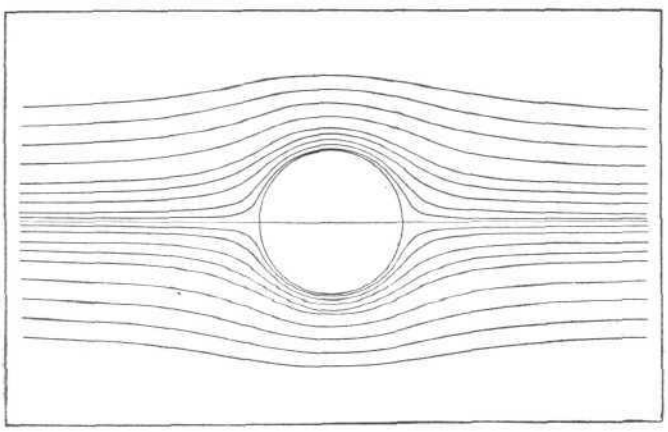


Fig. 5.

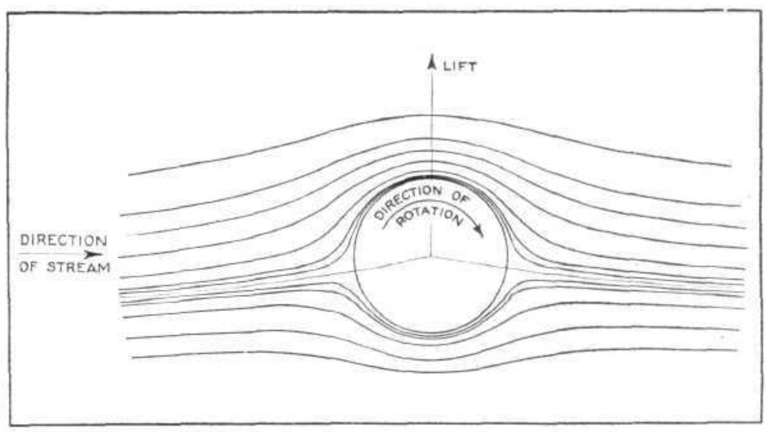


Fig. 6.

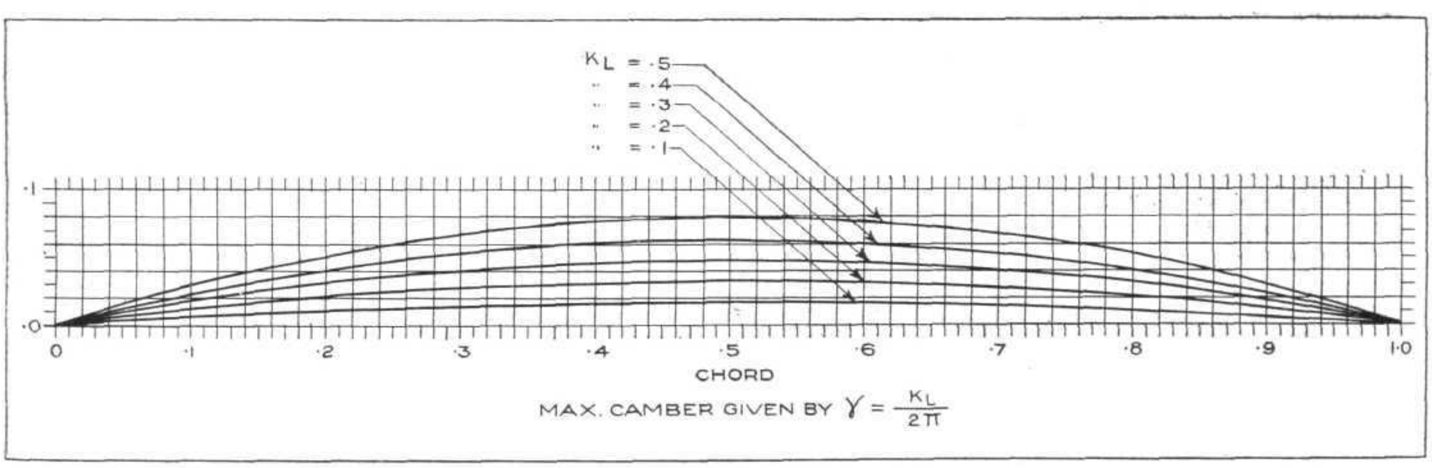


Fig. 7.

An interesting reference to Kelvin and Tate on analogous results on spinning tennis and golf balls may be found in the paper by A. R. Low already quoted. In this paper the graphical constructions now referred to are plainly set out, and those interested should study this valuable paper.

The remarks which applied to the Flettner rotor apply to the wing section; certain strengths of circulation can be shown to be appropriate to the aerofoil, and the flow and pressure systems studied. There is only one circulation to give conformable flow for each aerofoil, and in the viscid medium (air) the flow is not perfectly conformable. The minimum loss in eddy-making from boundary surface rollers, non-conformation at the tail, etc., occurs at that circulation which would give conformable flow in the ideal medium. It will be understood that circulation is only a relative term for the cyclic component added to the flow pattern, and that it results in a general curvature of the whole flow. The curvatures at *the centre line of the wing section corresponding to various* circulations are shown in Fig. 7, the circulations being expressed as lift coefficients.

We are now in a position to make a great simplification. It has been demonstrated experimentally that the phenomena of lift and centre of pressure movement are, for thin wing sections (*e.g.*, thickness not more than 0·125 of the cord), sensibly independent of the profile provided that it is of good streamline form and within the limits of circulation (or K_1 or incidence, whichever way you prefer to look at it) within which the flow is reasonably conformable. In other words, that the phenomena may be referred to the shape of the centre line of the aerofoil (*see* R. & M. 910). This plainly has tremendous practical advantages; we can choose or construct by appropriate transformation streamline forms to contain the necessary wing structure and control the K_1 at which minimum profile drag will occur, and the movements of the centre of pressure within reason. Although the theory only holds good conformably, we shall see that a process of inspection will give valuable guide to probable values of maximum lift coefficients, and a limited amount of systematic experimentation will provide data from which a reasonably accurate estimate may be made of profile drag, and its variations from the minimum at most conformable flow.

It must not be forgotten that all this time we are discussing a wing of infinite span, but the adjustments on account of practical span limitations do not invalidate these conclusions.

(To be continued.)

AEROPLANE JOINTS AND FITTINGS.

By F. M. GREEN, M.Inst.C.E., F.R.Ae.S.

The best method of fastening things together is a problem in all branches of engineering. A chain is only as strong as its weakest link. We must see to it that the weakest link is very little weaker than the strongest, otherwise the chain will be heavier than it need be. In the structure of an aeroplane weight is, and always will be, one of the most important factors, and for this reason designers of aeroplanes spend far more time and thought in the scheming and designing of joints and fittings than almost anyone imagines.

In the making of wooden aeroplanes many methods are used in the jointing of the wings and fuselage. The peculiar difficulties of using wood have been largely overcome, but there is always the problem of providing enough bearing area to prevent the joints working and the structure becoming gradually less rigid. Trouble is always likely to be caused by the shrinkage of the wood and by the deterioration of the glue that seems to be a necessity in wooden construction. It is not proposed to deal with the various types of joints and fittings that have been designed for wooden aeroplanes. The purpose of this article is to discuss methods of joining together metal structures which, in most people's opinion, are bound to displace wooden structures in the near future.

The methods of fastening two pieces of metal together can be divided into three classes :—

(1) Welding by acetylene blow-pipe, or by various electrical methods.

(2) By brazing, silver-soldering, or soft soldering.

(3) Mechanical joints, *e.g.*, by bolting and riveting.

All of these methods have their advocates, and all of them possess their advantages and disadvantages. It will be useful to state the pros and cons of each system before giving the writer's reasons for the use of the system which he prefers.

1. Welding.

If it were possible to join two pieces of metal together by the application of heat and pressure in such a way that the internal structure of the material remains unchanged, and if it were also possible to do this without distorting the external structure, then welding would offer great advantages. Unfortunately the metals that can usefully be used in aeroplane construction do not fulfil these conditions. The structure of steel and of the light aluminium alloys is a complex arrangement of crystals and binding matter, which is all too easily altered by the application of heat. The only

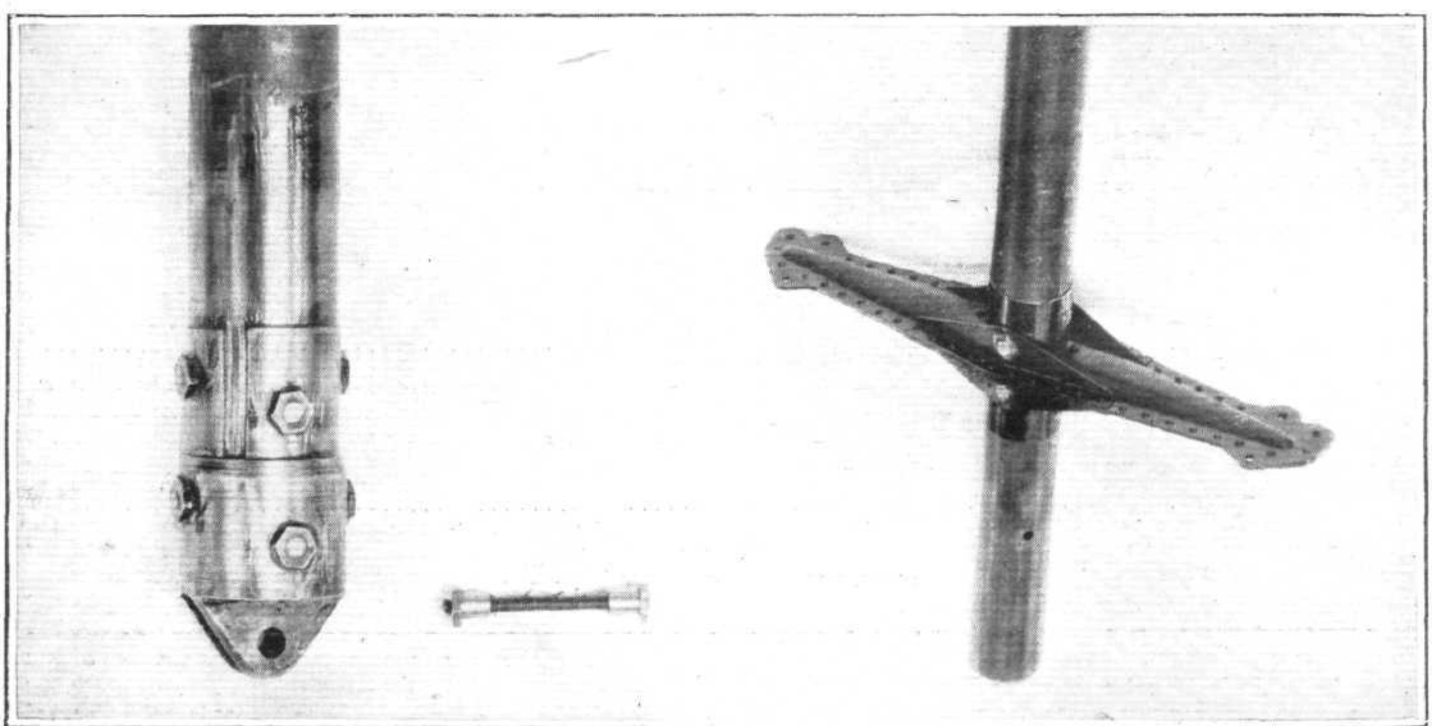


Fig. 1 (on left) shows a typical mechanical joint, in which fastening is by collar nuts and screwed tie-rods. Fig. 2 (right), shows rudder lever made up by riveting.

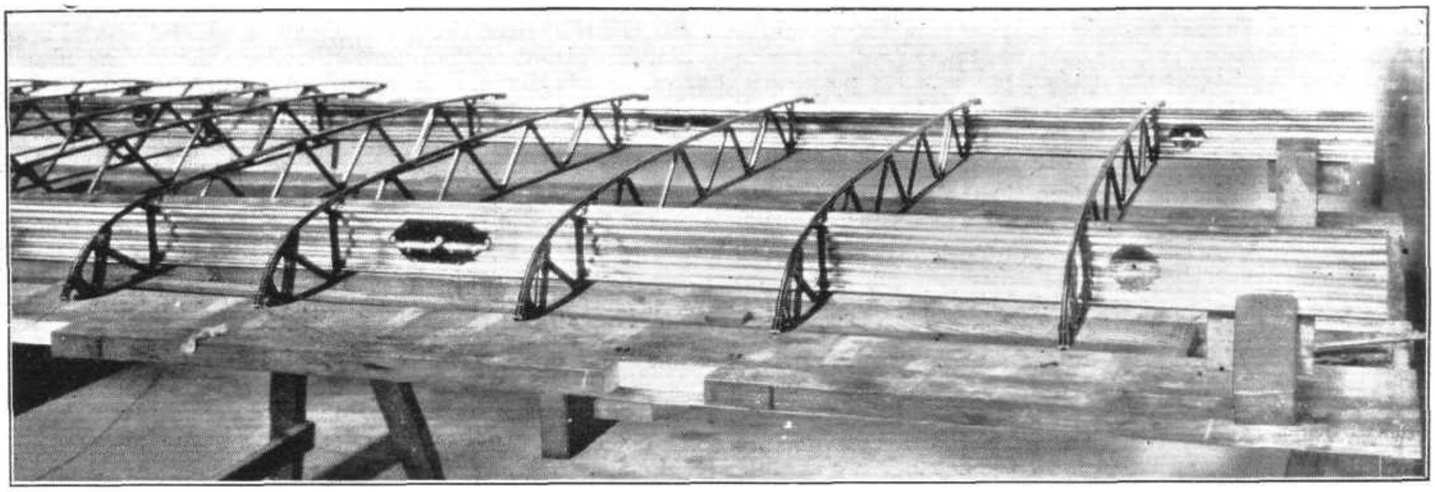


Fig. 3. Wing assembly of Armstrong-Whitworth metal wing. In this view the leading edge has not yet been clipped on.

material that can be welded with a reasonable certainty of uniform results is a low carbon steel which has low specific strength, and even when using this material one can only depend upon a tensile strength of about 16 tons to the square inch at the joint. It is true that in America frames are being made of alloy steel welded together electrically, but it seems very doubtful whether we can depend upon 100 per cent. of good joints, and also whether the material round about the weld would be in a satisfactory condition.

The advantage of using acetylene welding is that with a comparatively small selection of tube and sheet it is possible to make up a variety of joints without much preparation in the drawing office and with a minimum number of machined parts. With skilled welders repairs can be made with very little material. It is on record that one well-known designer of aeroplanes who uses a welded steel frame decided that a new design was lacking in stability, and that without more ado he had the frame sawn in half, a new bay welded in, and the aeroplane was flying again the next day.

It is frequently contended that the use of acetylene welding will cheapen manufacture. In small quantities this is probably correct, because the proportion of drawings, machined parts, press tools, and so forth that are required for frames or other constructions involve a large additional expenditure. At the same time the writer is quite sure that for quantity manufacture the use of welded fittings is a serious disadvantage. Apart from the cost of the welding operations, the accuracy of the welded parts is never likely to be great enough to make jig assembly possible, and all our experience goes to show that it is only by making interchangeable parts that can be assembled with the minimum of labour that economic production is assured. It is the writer's opinion that while a welded steel frame is probably better than a wooden frame it is much heavier than it need be on account of the low strength of the materials used; that there will always be some uncertainty as to the welding, whether it is done by acetylene blowpipe or by an electrical method; and finally, that the frame in quantities will be more costly to produce than one which is jointed together by mechanical means.

2. Brazing and Soldering

have much the same disadvantages as welding, but as the temperatures that are used are lower the harmful effect is somewhat less. The writer has used steel metal fittings joined together by dip brazing, and when these have been made of mild steel the results are satisfactory. It is possible to use higher tensile steels and to heat-treat after brazing, but there is a tendency for the brass to penetrate the higher tensile steels and cause brittleness, which frequently leads to cracks. The process of dip brazing, in which the part to be brazed is plunged into a molten bath of brazing metal, is much to be preferred to hearth brazing, as temperature control is easier and the whole job is cleaner and more reliable. The objection to the method is that there is a great deal of cleaning up to do after brazing, and this is very much more costly than might be expected. It is particularly difficult to clean the brazing metal out of a hole, as the metal itself is generally too thin to allow of a machining operation.

It is not possible to braze together a complete frame without the use of sockets, and it is scarcely advisable to braze with sockets, as this makes it difficult to use high tensile steels for the tubes of the frame-work. It is of course common practice with bicycle frames, but only the mildest of steel tube is generally used.

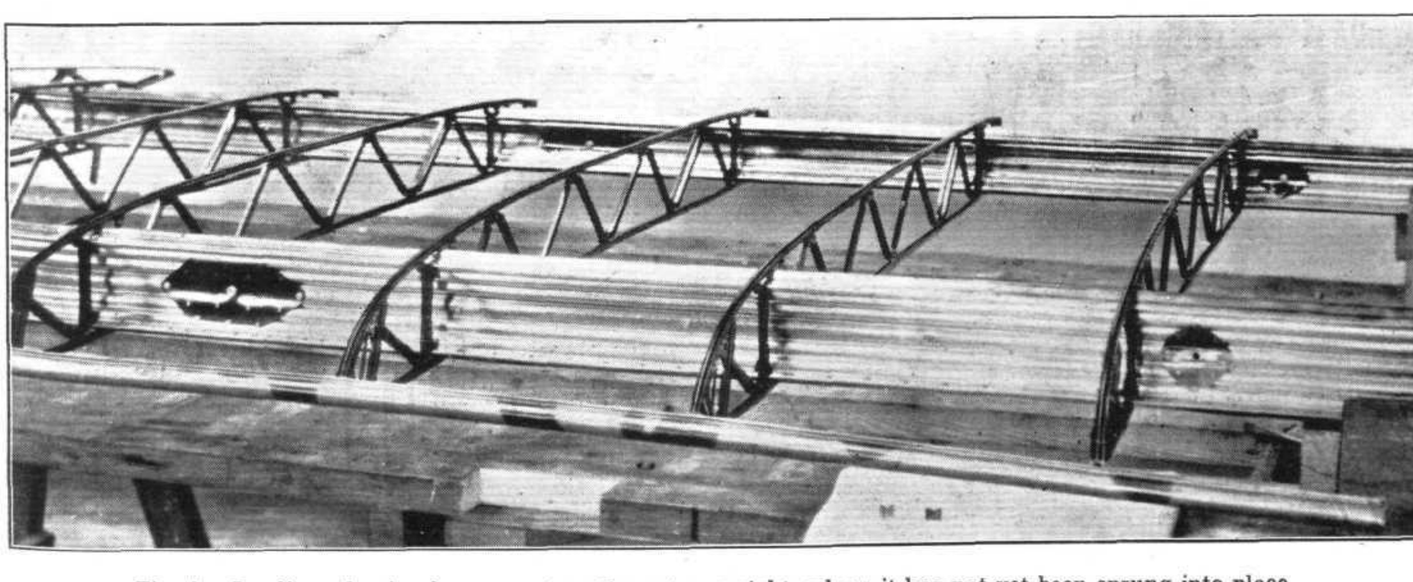


Fig. 4. Leading edge in place except on the extreme right, where it has not yet been sprung into place.

Silver soldering has much the same disadvantages as brazing, but it is carried out at a somewhat lower temperature, and it makes a very strong job. It is scarcely ever used, partly on account of the cost of the silver solder, but chiefly because ordinary brazing is generally good enough, and the temperature is still not low enough to get away from ill-effects on high tensile steels.

Soldering with low temperature tinman's solder need not affect high tensile tubing, but a good deal of care and supervision is necessary, because it is easily possible to raise the temperature higher than needed. So long as joints made with soft solder are in pure shear, and there is little direct tension or tearing action, soldered joints will stand up to a shear of 2 tons per square inch. It is generally considered advisable to reinforce the joint with taper pins or rivets up to at least two-thirds of the strength of the joint. Sockets built up of sheet metal and dip brazed can be soft soldered on to tubes without difficulty, and the writer has experience of a number of frames built up in this way that have been quite successful. The chief objection to the method is that it is expensive. A great deal of care has to be taken in making each joint, particularly to ensure that it is properly cleaned of flux. If this is not done corrosion is almost certain to start sooner or later.

3. Mechanical Joints.

It was on account of these manufacturing difficulties that the attempt was made to make up a frame which was fastened together entirely without welding, brazing or soldering. The problem is fairly simple if channel or angle sections are used for the frame, but for various reasons it was decided to keep to round steel tube. The difficulty in making a frame that is bolted together is in keeping the joints tight and preventing them from working and fretting the holes. Very accurately fitting bolts would put up the cost of manufacture, while rivets are not convenient for use with tubes. The system which was eventually adopted is illustrated in Fig. 1. The tube itself is reinforced by a sleeve, generally of the same size tube, split lengthways and sprung into place, and the actual fastening is made by using collar nuts fastened together with a screwed tie-rod across the diameter of the tube. Direct tension tests were made of samples joined in this manner, when it was found that the apparent bearing pressure at which the joint failed was about 150 tons to the square inch on the surface of the collar nuts if friction were neglected. As this is a much higher bearing pressure than the metal will take it was obvious that friction could not be neglected, and that it was in fact largely by means of friction that the joint held together. This encouraged us to use the joint on a large scale, and it has been found to be completely successful in a number of steel fuselages in aeroplanes that have been supplied to the Air Force and also in aeroplanes used by the Armstrong Whitworth Reserve Training School. The joints are quite rigid and show no signs of movement after hundreds of hours of flying and thousands of landings.

The advantages of using a purely mechanical joint are many. In the first place, frames can be built up on jigs and the saving of time in erecting and trueing a frame in this way is considerable. The frame is very much more easily repaired, because a member can be easily replaced, and finally there is the big advantage that the tube can be used in its best heat-treated state and there is no fear of spoiling it or rendering it liable to corrosion. Hitherto the writer has only experienced this method as applied to steel tube, but there seems no reason why it should not be used with equal success to fasten light alloy tubes.

Besides the wings and fuselage there are a number of other places in an aeroplane where riveted-up units can be used. It has been common practice to make the levers that work the ailerons, elevator and rudder of a stream-line shape by welding two steel pressings together. An alternative way of making up the same pieces is illustrated in Fig. 2. It will be noted that no welding is used and that the whole construction is riveted together and can be fixed to a tube by means of a ferrule, nuts and tie-rods. A similar lever can be made in aluminium alloy.

There is still another way by which components can be joined together. This has been used extensively in the metal wings made by Sir W. G. Armstrong, Whitworth Aircraft Ltd., and is best understood by referring to the illustrations, Figs. 3 and 4, where the attachment of a rib to the leading edge of the plane is shown. The rib itself is made up complete with an aluminium fitting in each end (Fig. 3). The leading and trailing edge sections are pushed over this, as shown in fig. 4. In order to illustrate the method the leading edge on the right-hand side of the picture has not yet been sprung into place. The leading edge is locked into place by means of two small clips, one on each side of the rib. These clips embrace the lips of the section and are slid up into place close alongside the rim. It has been found in practice that no further locking is necessary.

There are many other types of joints which might be described, but the few illustrations given are intended only to show that mechanical jointing is not necessarily a difficult or costly process. The examples chosen have all been tested out on Service aeroplanes with results that have been perfectly satisfactory, while the economy in manufacturing has been at least up to expectations.

NOTES ON THE GROUND OPERATION OF FLYING-BOATS.

By R. J. MITCHELL, Assoc.M.Inst.C.E., A.F.R.Ae.S.

Sometime in the future the design of flying-boats will have reached a state of development at which they can be moored out for indefinite periods. Even at the present time, modern flying-boats are often moored out for quite long periods, especially when carrying out extended cruises away from their base. It is the usual practice, however, for them to be brought ashore and housed in hangars when not in operation, and no matter what state of development flying-boats reach, it will always be desirable to bring them ashore periodically for inspection, maintenance and repair, just as an ocean liner is dry-docked for its periodic overhaul. It may be argued that large flying-boats may be dry-docked in a similar manner, but it is considered that for the sizes at present being built, and contemplated building, it will be found much more efficient and economical to bring them ashore.

The methods employed in launching, bringing ashore, and handling flying-boats on the ground are of very great importance, and have a very considerable bearing on the length of their useful lives.

The Beach Cradle has generally been used and is still used to a large extent for this purpose. It consists of a cradle, mounted on swivelling wheels, which is made to fit the bottom of the hull amidships for a considerable portion of its length. The beach cradle has been found to have many disadvantages, the chief of which is its liability to damage the hull. It is often stated on very good authority that more damage occurs to flying-boats during the use of beach cradles than during all the remainder of their normal operations.

Some early efforts were made to eliminate the beach cradle by fitting an axle through the hull fitted with external detachable wheels. This was not very successful, however, as the intense localisation of the loads at the axle was found to be very little better for the hulls than the beach cradle, and was liable to cause leakage unless the hulls were strengthened very considerably.

It was not until the development of the boat amphibian that the great advantages of the amphibian type of chassis for launching and beaching were realised, and that by designing a chassis which could be very easily fitted or removed, the advantages could be utilised for flying-boats.

A chassis of this type has been designed and has been extensively used for the operation of the "Southampton" type flying-boats. The accompanying photographs serve to illustrate its general features and method of operation. The chassis is made in two separate parts, one to fit on each side of the hull. Each part consists of a light tubular frame built on to a bent axle carrying an aero wheel. An adjustable strut is pinned to the axle near to the wheel in such a way that it is free to swivel in the plane of the axle through

a certain fixed angle. This strut is made in the form of a large turnbuckle with a right- and left-handed screw and is lengthened and shortened by turning the hand wheel in the centre. The buoyancy of the wheels is easily sufficient to keep afloat the whole chassis. Each half of the chassis is attached to the hull at two points, these being the bases of the wing root struts. The inner end of the axle forms one point of attachment and the end of the rear chassis strut, the other attachment. These attachments are made with very slack fitting pins in a horizontal plane, thus enabling the chassis to swing up and down. The upper end of the adjustable strut is attached to the front spar of the lower plane at its point of attachment to the front wing root strut. It will be seen that by lengthening and shortening the adjustable strut by means of its central control wheel the chassis is lowered and raised and swings about its two points of attachment on the hull.

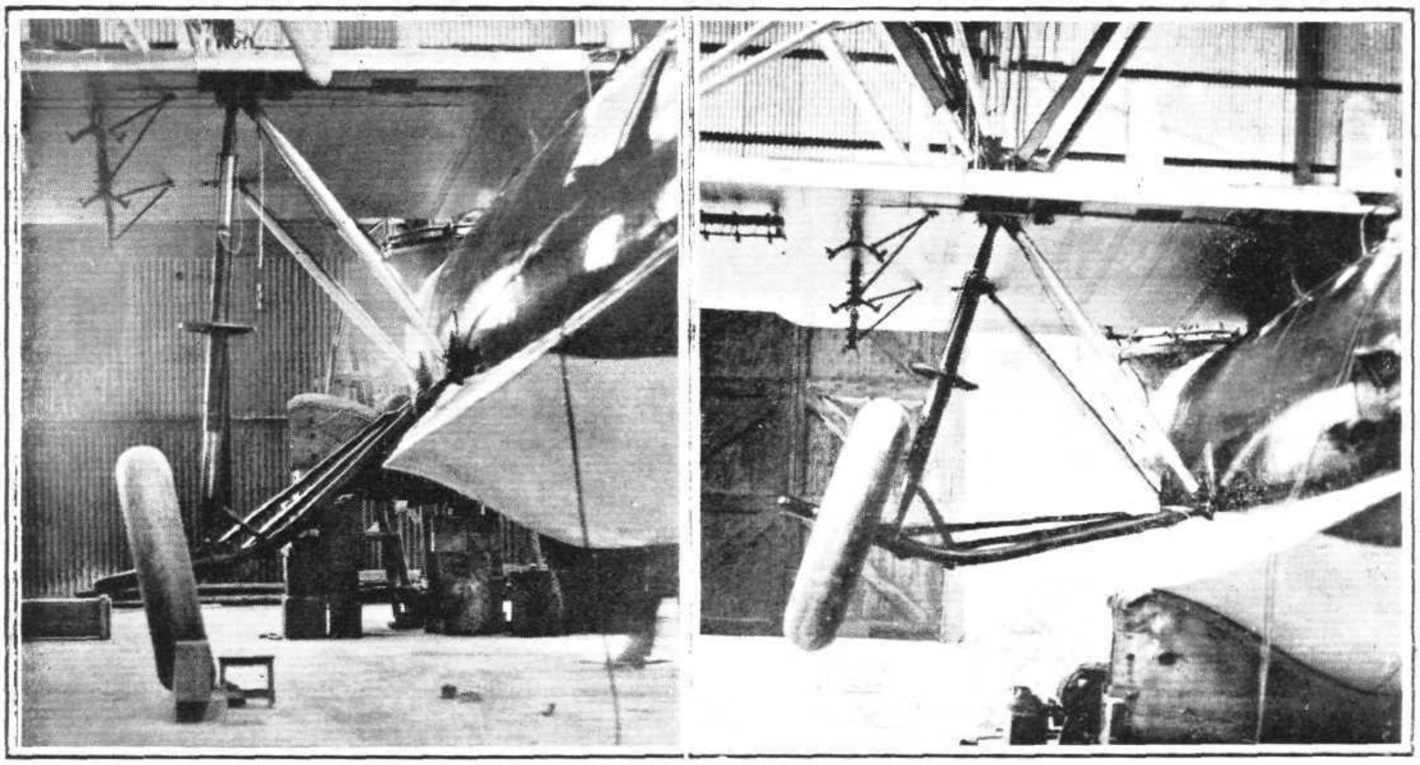
The chassis can be attached to the flying-boat when afloat. This can be done at its moorings by means of a boat, or from the slipway by bringing the flying-boat in to the slipway stern first. The two attachments on the hull are first made.

The following are some of the advantages claimed for this type of handling chassis over the beach cradle :—

Liability to Damage Due to Handling.

The beach cradle takes the weight of the flying-boat through a portion of the bottom of the hull, and thus places on the hull loads of a different nature from those experienced in other ways. The bottom of the hull forms a very narrow base for support in comparison with the span, and this causes rocking of the flying-boat on its beach cradle during handling, or when resting in even a light breeze. This, in turn, causes "working" of the hull and liability to subsequent leakage.

When launching a flying-boat or bringing it ashore by means of a beach cradle, there occurs a very critical period during which serious damage may very easily be done. This period occurs during the change over from the flying-boat being water borne and cradle borne. If the sea is a little rough, or is affected by the swells from passing steamers, the hull is very liable to be hammered on to its cradle by a series of heavy blows. This usually happens when the



BEACHING CHASSIS OF SUPERMARINE "SOUTHAMPTON." On the left the chassis is shown in the down position, while on the right it is shown at the top of its travel.

The attachment pins are a very slack fit and the joints have a big lead into their sockets, so that the attachments are very easily made. The chassis will now float so that the upper end of the adjustable strut, which is shortened to its limit, can be conveniently attached to its socket on the lower plane in a similar manner. The adjustable strut is now lengthened and the chassis forced down into its lowest position. By the use of a light tail trolley the flying-boat can now be drawn out of the water and handled on the ground in exactly the same manner as a normal type of land machine.

Owing to the necessity of packing flying-boats as closely as possible in their hangars, in order to economise hangar space, it has been found necessary to be able to move them in any direction, especially sideways, without the usual backward and forward manœuvring. This requirement is analogous to that of motor-cars in a closely-packed garage and can be satisfied in an exactly similar manner by the use of skates with swivelling rollers. The flying-boat can be wheeled on to a pair of these skates, made to fit the chassis wheels, and can then be side-tracked or moved in any direction.

cradle is not in its proper place, with the result that the bottom of the hull receives these blows on projecting parts of the cradle.

The handling chassis carries the main weight of the flying-boat from points on the wing structure, and the hull is suspended from these points in a similar manner to when the machine is in the air. The loads due to handling are thus taken through the structure in a manner analogous to the flying loads. No additional strengthening of the hull or structure is, therefore, necessary, and the flying-boat can be roughly handled or left out in the open in rough weather without fear of damage. The use of the handling chassis eliminates the causes of damage attributable to the beach cradle, as when the chassis is attached and lowered into position the flying-boat can alternate between its chassis-borne and water-borne conditions without the least harm.

Ease of Operation.

The operations of launching and bringing ashore by means of a beach cradle require the use of a large crew, specially trained to the job, and who can be relied upon to use great care and very considerable skill.

The handling chassis can be used with a considerable saving in personnel and time, and its operation can be made much more of a routine job.

Accessibility of Hull.

When a flying-boat is resting on a beach cradle, a large portion of the bottom of the hull is not available for inspection, repair, painting, etc. To carry out these operations the machine has to be removed from its cradle by jacking up or lifting, a very tedious and precarious job.

Furthermore, this portion of the hull is in more or less constant contact with the padding of the cradle, which is soaked with sea water. This is a matter of vital importance when duralumin hulls are considered as the portion of the hull in contact with the sea water soaked cradle is seriously liable to corrosion, and is not even available for inspection without considerable work.

The handling chassis eliminates all these disadvantages, and leaves all parts of the hull quite accessible.

Transportation.

Beach cradles for large flying-boats are necessarily heavy and cumbersome, and difficulty is experienced in transporting them by rail or boat.

A handling chassis is light and comparatively small, and can be transported without difficulty.

Sphere of Operation.

In spite of its name, the beach cradle can only be used successfully on a slipway, and considerable difficulty would be experienced on the average type of natural beach. The handling chassis has a much larger sphere of operation, and can be used quite efficiently under these circumstances.

The use of the handling chassis for flying-boats may be described as a recent development, and the experience available is not very extensive. There is little doubt that considerable improvement can still be made as our experience increases. There is every indication, however, that the use of the handling chassis will prove a very important step in the efficient and economical operation of flying-boats.

TECHNICAL LITERATURE.

A.R.C. REPORTS.

HIGH-FREQUENCY FATIGUE TESTS

By PROFESSOR C. F. JENKIN, C.B.E.

Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research.

R. and M., No. 982 (M. 30). October, 1925. Price 9*d*. net.

The experiments on high-frequency fatigue in copper, Armco iron, and mild steel described in the following paper were carried out in the Engineering Laboratory, Oxford, at the suggestion of the Elasticity and Fatigue Panel of the Aeronautical Research Committee. The question is of importance to the users of high-speed machinery.

In 1911 Professor B. Hopkinson* called attention to the importance of ascertaining whether the fatigue limit of metals was dependent on the rate of alternation of stress. He designed and made an electric alternating direct-stress machine, and published the results of tests on mild steel carried out at about 7,000 periods per minute (116 per sec.), which was more than three times as fast as any tests made up to that time. The results at this speed were compared with those made by Dr. Stanton at the National Physical Laboratory on the same material at 2,000 periods per minute (33 per sec.). Professor Hopkinson considered that the results showed that speed had a marked effect, but he did not consider that his tests were conclusive. In the light of the knowledge gained on fatigue testing since that date neither set of tests can be considered satisfactory.

After a large number of tests using the apparatus rotating at a frequency of 100 periods per second, which was later increased for tests with torsional vibrations at large amplitudes to 5,000 periods, the experiments were ultimately abandoned. The apparatus was found not to be powerful enough to overcome the large hysteresis which appeared as the fatigue limit was closely approached, the power being apparently limited by the magnetic saturation of the iron in the armature. The amount of the strains actually attained in typical experiments were as follows :—

Test piece made of copper tubes or copper rods, of diameter about $\frac{1}{10}$ in., and the effective length 3 in. ; approximate stress was between 3·3 and 3·7 tons per square inch and the strain 0·0012.

The specimens remained unbroken after upwards of 10^7 periods.

* Roy. Soc. Proc., A. Vol. 86. November, 1911.

SOME EXPERIMENTS ON A MODEL OF A B.A.T. "BANTAM" AEROPLANE WITH SPECIAL REFERENCE TO SPINNING ACCIDENTS.

PART I.—LONGITUDINAL CONTROL AND ROLLING EXPERIMENTS.

By H. B. IRVING, B.Sc., and A. S. BATSON, B.Sc.

PART II.—EXPERIMENTS ON FORCES AND MOMENTS (INCLUDING RUDDER CONTROL).

By H. C. H. TOWNEND, B.Sc., and T. A. KIRKUP.

R. & M. No. 976 (Ae. 190). November, 1925. Price 1*s*. 3*d*. net.

The spinning of aeroplanes is a problem which has engaged the attention of the Aeronautical Research Committee on several occasions, and the first report dealing with the subject in much detail is R. & M. 618.* The experiments described in the present paper relate to difficulties experienced in coming out of a spin by a certain type of aeroplane which was in other respects a very nice machine to handle.

Non-Rotational Experiments.—Measurement of pitching moment (including elevator control) over a large range of incidence and for angles of yaw up to 40° on the model with standard wing gap (0·81 × chord) and model with gap increased to 1·03 × chord.

Rotational Experiments.—Measurements of auto-rotational speeds and couples were made for the complete model with standard and increased gaps (no yaw), and the auto-rotation of the yawed model measured about an axis through the centre of gravity of the aeroplane (angle of yaw 30° ; original gap) ; pitching and yawing moments due to rolling were also observed (wings only).

Non-Rotational Experiments.—The pitching moments and longitudinal control of the "Bantam" do not appear to possess any unusual features. Sideslip (or yaw) produces a pitching moment tending to increase the angle of incidence ; the magnitude of the moment is similar to that observed in the case of the S.E.5A model. The longitudinal control is practically unaffected by sideslip. Increasing the wing gap by raising the upper plane had very little effect on either pitching moment or longitudinal control.

Rotational Experiments.—The "Bantam" has an abnormally high speed and large range of auto-rotation.

Sideslip corresponding to 30° yaw completely stopped auto-rotation at any angle of incidence, the ailerons being set so as to balance the rolling moment due to sideslip ; raising the upper plane of the model reduced the range and maximum speed of auto-rotation. Pitching moment due to rolling was found to become positive at large angles of incidence, but its magnitude was always small compared with the control available.

The high speed and large range of auto-rotation of the "Bantam" are shown to be easily explainable by the absence of stagger and by the small wing gap of this aeroplane. The results are then discussed with special reference to the problem of difficulty in recovery from a spin, attention being chiefly directed to the various factors affecting the longitudinal trim during a spin.

Effect of Inertia Term.—Attention is drawn to the importance of the inertia term in the equation of pitching moments for the conditions of a spin, particularly when the characteristics of a biplane, *e.g.*, small wing gap combined with zer

* R. & M. 618. "The Investigation of the Spin of an Aeroplane." B. H. Glauert. June, 1919.

stagger, are such as to lead to high speed of auto-rotation at a large angle of incidence. Further, it is pointed out that such characteristics render a biplane less statically stable in pitch than one with larger gap and stagger, and therefore it has less tendency to "unstall" than is usual; it is shown that these characteristics are likely to lead to danger in recovery from a spin, unless the centre of gravity is well forward and/or there is a very good margin of control.

A considerable amount of further information is required before the conclusions of this report can be fully confirmed by quantitative analysis of the motion in a spin, but there seems little doubt that the features in design which may lead to danger in spinning have now been recognised and the reason for the danger understood to a large extent.

Other Work on the Subject.—Papers bearing on the subject of spinning to which reference is made in the above report are:—

R. & M. 828.—A continuous rotation balance for the measurement of L_p at small rates of roll.—Relf and Lavender.

R. & M. 936.—A continuous rotation balance for the measurement of pitching and yawing moments due to angular velocity of roll (M_p and N_p).—T. Lavender.

R. & M. 831.—On the effect of sideslip on the aerodynamic forces and moments (including those due to the controls) for a model S.E.5A aeroplane.—H. B. Irving and A. S. Batson.

R. & M. 787.—Lateral control of Bristol Fighter at low speeds. Measurement of rolling and yawing moments of model wings due to rolling.—F. B. Bradfield.

R. & M. 944.—Measurement of pitching moments due to roll of wings of Avro 504K.—F. B. Bradfield.

R. & M. 975.—Auto-rotation measurements on a model aeroplane with zero stagger.—Bradfield and Coombes.

R. & M. 848.—Rolling and yawing moments due to roll of model Avro wings, with standard and interplane ailerons and rudder moments for standard and special large rudder.—R. A. E.

R. & M. 733.—Preliminary note on the effect of stagger and decalage on the auto-rotation of a R.A.F.15 biplane.—Irving and Batson.

THE REPRESENTATION OF AIRCRAFT PERFORMANCE TESTS, USING NON-DIMENSIONAL VARIABLES, WITH SPECIAL REFERENCE TO THE PREDICTION OF THE EFFECTS OF CHANGE OF LOADING ON PERFORMANCE.

By R. S. CAPON, B.A. PRESENTED BY THE DIRECTOR OF SCIENTIFIC RESEARCH.

R. and M., No. 984 (Ae. 196). November, 1925. Price 4*d*. net.

In Bairstow's "Applied Aerodynamics," Chapter IX, a method of plotting a performance test, using non-dimensional co-ordinates, is described, which has a particular application to the estimation of the effect of change of loading on performance. The application to maximum rates of climb is stated not to be rigorous, however, and this also applies to the formulæ of prediction of change in performance with change of load given in R. and M. 608.

In the present paper the condition is investigated under which the application is rigorous to maximum rates of climb, air speeds for maximum rates of climb, and corresponding airscrew rotation rates; a convenient formula for deducing the maximum rates of climb, maximum angles of climb, etc., for one loading from known values for another loading deduced; and the applicability of the formula checked in so far as rates of climb are concerned by reference to results of tests at Martlesham. A slide rule is described which facilitates the computations.

It is shown that dimensional theory may be applied rigorously when the engine power is proportional to any power, integral or fractional, of the airscrew rate of rotation, and that in this case maximum rates of climb and the corresponding air speeds and airscrew rates of rotation, as well as maximum level speeds with the corresponding airscrew rates of rotation, may be obtained at one loading from tests at another loading by a simple calculation. It is further shown that to a close approximation the calculation reduces to re-plotting the observed values of the above quantities at standard height H at a height H^1 such that the ratio of the power factors at the heights H and H^1 is equal to the ratio of the flying weights.

It is proposed to check more accurately the validity of the method by further tests at two flying weights, first determining the power factors by an independent series of tests.

ON THE SYSTEM OF VORTICES GENERATED BY A CIRCULAR CYLINDER IN STEADY MOTION THROUGH A FLUID.

By C. N. H. LOCK, M.A.

R. and M. No. 986 (Ae. 198). (6 pages and 3 diagrams.) November, 1925. Price 4*d*. net.

This paper deals with the Kármán theory of the wake left behind the cylinder which takes the form of a double row of two-dimensional vortices, and suggests that the recent results obtained at higher values of the Reynolds number (see R. and M. 825)* may have a bearing on the application of the theory when there is a certain change with increase in speed in the resistance and frequency coefficients observed in the neighbourhood of ($VL/\nu = 10^5$). The note concludes not that the Kármán regime ceases to apply at the higher Reynolds number, but that the sudden drop in resistance at $VL/\nu = 4 \times 10^5$ corresponds to the sudden increase of frequency and decrease of the distance between the rows.

* R. & M. 825. "On the sound emitted by wires of circular section when exposed to an air current." By E. F. Relf. Phil. Mag. ser. 6 XLII, p. 173. 1921.

NOTE ON THE MINIMUM SPEED FROM WHICH THE DIRECTION OF A GLIDING AEROPLANE CAN BE CHANGED TO A HORIZONTAL PATH FOR LANDING.

By F. W. MEREDITH, B.A. PRESENTED BY THE DIRECTOR OF SCIENTIFIC RESEARCH.

R. & M. No. 993 (Ae. 204). June, 1925. Price 4*d*. net.

Recent improvements in the control of aeroplanes at low speeds raise the question of the minimum speed at which it is safe to come in to land with an under-carriage which has usually not been designed to absorb the whole of the vertical velocity present during a glide. In the analysis of the present paper it has been assumed that the aeroplane is flying horizontally at the moment of contact of the wheels with the ground, so that the motion of approach to the ground is that at which the wings are giving the maximum possible lift.

It is concluded that for a normal aeroplane the speed must be about 20 per cent. above the stalling speed, to provide the necessary excess lift for flattening out under the above hypothesis.

THE AIR-BUBBLE VISCOMETER.

By GUY BARR, B.A., D.Sc.

Work performed for the Department of Scientific and Industrial Research.

R. and M. No. 988 (M. 31). April, 1925. Price 9*d*. net.

It was desired to find whether, and under what circumstances, the rise of a large bubble in a vertical tube containing liquid could be used as an indication of the viscosity of the liquid.

The method has been used by Faust ("Zeits. Phys. Chem.," 1919, 39, 758) for very viscous oils; by Abrams, Kavanagh and Osmond ("Chem. and Met. Eng.," 1921, 25, 665) for oils of 0·15 to 0·9 poise, and by Gardner and Holdt (Circ. No. 128 of Paint Manufacturers' Association of the U.S., 1921) in varnish works for oils of viscosity between 0·5 to 5·5 poises.

The effects of length of bubble and diameter of tube have been examined, and the rate of rise determined for several oils of known viscosity and surface tension, for water and for glycerin in different tubes. A dimensional analysis of the problem has been made involving certain assumptions which seem to be capable of verification, in any particular case, from the appearance of the bubble.

Above a certain limit the length of the bubble is without appreciable effect on the rate of rise. For bubbles rising "slowly" in a given tube, *i.e.*, at such a rate that not more than one thickened annulus of liquid appears between the bubble and the walls towards the rear end of the bubble, it has been found that the rate of rise is inversely proportional to the kinematic viscosity provided that the surface tension is constant. An approximate determination has been made of the form of the function of r/a upon which, in addition to the viscosity, the rate of rise depends. In certain conditions, *e.g.*, when light oils are examined in a tube of such a diameter as to give a convenient rate of rise, the rate may vary about 14 times as fast as the diameter and six times as fast as the surface tension, but these effects become very much less pronounced when viscous liquids are used in wide tubes.

The air bubble viscometer may be used with confidence for the approximate comparison of viscosities of materials of the same class. A simple modification is suggested which enables a check to be made on the assumed constancy of surface tension.

AMERICAN NATIONAL ADVISORY COMMITTEE REPORTS.

The National Advisory Committee for Aeronautics in the United States of America corresponds to our own Aeronautical Research Committee, and perhaps it may be said that the publications issued by the American body score over those published in this country by being issued much more rapidly than is usually the case with the British Reports and Memoranda. Two distinct classes of reports are issued, the first being known as Technical Reports. These are printed and illustrated by photographs and/or drawings and diagrams. The second class are known as Technical Notes, and are issued in mimeographed form so as to enable them to be rapidly distributed to a somewhat smaller, but directly interested circle of readers. Copies of the Reports and Notes can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D.C., U.S.A., but the American N.A.C.A. have a Technical Assistant in Europe, whose office is at 18, Rue Tilsitt, Paris, France, from whom, we understand, copies can be obtained. Readers who are in a hurry to obtain copies of the reports are advised to write to him, as usually some considerable time will be saved by so doing.

In so far as space permits, we hope to publish regularly in THE AIRCRAFT ENGINEER summaries of these American Reports and Notes as they are issued. In the meantime, the following summaries of the Reports published in 1925, and list of Technical Notes issued last year, may be of interest.

Summaries of Technical Reports Published in 1925.

Report No. 210, entitled "Inertia Factors of Ellipsoids for Use in Airship Design," by L. B. Tuckerman, Bureau of Standards.—This report is based on a study made by the writer as a member of the special committee on design of Army semi-rigid airship "R.S.1" appointed by the National Advisory Committee for Aeronautics.

The increasing interest in airships has made the problem of the potential flow of a fluid about an ellipsoid of considerable practical importance. In 1833, George Green, in discussing the effect of the surrounding medium upon the period of a pendulum, derived three elliptic integrals, in terms of which practically all the characteristics of this type of motion can be expressed. The theory of this type of motion is very fully given by Horace Lamb in his "Hydrodynamics," and applications to the theory of airships by many other writers. Tables of the inertia coefficients derived from these integrals are available for the most important special cases. These tables are adequate for most purposes, but occasionally it is desirable to know the values of these integrals in other cases where tabulated values are not available. For this reason it seemed worth while to assemble a collection of formulæ which would enable them to be computed directly from standard tables of elliptic integrals, circular and hyperbolic functions and logarithms without the need of intermediate transformations. Some of the formulæ for special cases (elliptic cylinder, prolate spheroid, oblate spheroid, etc.) have been published before, but the general forms and some special cases have not been found in previous publications.

Report No. 211, entitled "Water Model Tests for Semi-rigid Airships," by L. B. Tuckerman, Bureau of Standards.—The design of complicated structures often presents mathematical problems of extreme difficulty which are frequently insoluble. In many cases, however, the solution can be obtained by tests on suitable models. These model tests are becoming so important a part of the design of new engineering structures that their theory has become a necessary part of an engineer's knowledge.

For balloons and airships water models are used. These are models about 1/30 the size of the airship hung upside down and filled with water under pressure. The theory shows that the stresses in such a model are the same as in the actual airship.

In the design of the Army semi-rigid airship R.S.I no satisfactory way was found to calculate the stresses in the keel due to the changing shape of the bag. For this purpose a water model with a flexible keel was built and tested. This paper gives the theory of the design, construction, and testing of such a water model.

Report No. 212, entitled "Stability Equations for Airship Hulls," by A. F. Zahm.—In the text are derived simple formulæ for determining, directly from the data of wind-tunnel tests of a model of an airship hull, what shall be the approximate character of oscillation, in pitch or yaw, of the full-scale airship when slightly disturbed from steady forward motion.

Report No. 213, entitled "A Résumé of the Advances in Theoretical Aeronautics made by Max M. Munk," by Joseph S. Ames.—In order to apply profitably the mathematical methods of hydrodynamics to aeronautical problems, it is necessary to make certain simplifications in the physical conditions of the latter. To begin with, it is allowable in many problems, as Prandtl has so successfully shown, to treat the air as having constant density and as free of viscosity. But this is not sufficient. It is also necessary to specify certain shapes for the solid bodies whose motion through the air is discussed, shapes suggested by the actual solids—airships or airfoils—it is true, but so chosen that they lead to solvable problems.

In a valuable paper presented by Dr. Max M. Munk, of the National Advisory Committee for Aeronautics, Washington, to the Delft Conference in April, 1924, these necessary simplifying assumptions are discussed in detail. It is the purpose of the present paper to present in as simple a manner as possible some of the interesting results obtained by Doctor Munk's methods.

(*To be continued.*)

CORRESPONDENCE

In order to leave as much space as possible for new articles in THE AIRCRAFT ENGINEER each month, letters dealing with the various points raised will be published in the Correspondence columns of *Flight* week by week. Letters referring to the article by Mr. Frank Courtney on "Stalled Flight and Control," which appeared in the February 25 issue, will be found in *Flight* of March 4 (Mr. R. Reynolds and Capt. B. Thomson), March 11 (Capt. G. de Havilland and Mr. Courtney), and March 18 (Mr. R. Reynolds).

ERRATA

Although a correction was published in *Flight* of March 11 of two errors which crept into Mr. North's article on "Aircraft Performance," published in THE AIRCRAFT ENGINEER of February 25, it is thought that some of our readers may have missed these corrections, and consequently they are repeated here. On p. 13 the last words of the first paragraph should have read "gun fire" and *not* "gun power" as printed. On p. 15 the last word of the first line of column 2 should have been "mechanistic" and *not* "metaphysic."

Mr. R. Reynolds writes to point out that a small error crept into his letter published in the Correspondence column of *Flight* of March 18. In the seventh line from the bottom the words "stalled control" should read "slotted control."

ALAN COBHAM ENTERTAINED—AND HONOURED

MR. ALAN J. COBHAM, and his companions in the recent London—Cape Town—London flight, Mr. A. B. Elliott and Mr. B. W. G. Emmott, attended two important functions, held in their honour last week. The first was a banquet given at the Savoy Hotel by the Royal Aero Club and the Society of British Aircraft Constructors on March 17, at which the Duke of Sutherland presided and a number of well-known personalities of the aviation world were present. In giving the toast of the flight the chairman paid tribute to Mr. Cobham and his companions for the accomplishment of this world-renowned flight, which he said was a triumph for British aviation. Sir Philip Sassoon (Under-Secretary for Air) also associated himself with the toast, which was supported by Mr. T. O. M. Sopwith on behalf of the S.B.A.C.

The second function was a luncheon given by the Aldwych Club at the Connaught Rooms on March 18. Sir Charles Wakefield presided and presented Mr. Cobham with a silver mug, saying that the flight to the Cape and back was one of historic importance, and that Mr. Cobham had beaten out an Imperial track and helped to lay the foundations of what would one day be a network of airways throughout the Empire.

Mr. Cobham, in responding on both these occasions, alluded to the fact that the flight was not made in order to find an air route from London to the Cape, but to ascertain the possibilities of intermediate air routes. He also briefly outlined some of their experiences and referred to his conclusions regarding the practicability of air services in Central Africa, which were most favourable.

The Air Ministry announces that H.M. the King has been pleased to approve the award of an Air Force Cross to Mr. A. J. Cobham, in recognition of the valuable and distinguished service he has rendered to aviation by his recent London—Cape Town—London flight and previous flights such as : (1) London—Rangoon —London ; (2) London—Egypt—Palestine—Syria—London ; (3) London—Tangier—London and (4) London—North Africa—Italy—London.

The gold medal of the Royal Aero Club has been awarded to Mr. A. J. Cobham in recognition of his services to aviation, and the bronze medal of the club has been awarded to Mr. A. B. Elliott, who accompanied Mr. Cobham as engineer on the London to Cape Town flight.

Tomorrow, March 26, Mr. Cobham will personally describe his flight to Cape Town and back at the Aeolian Hall, New Bond Street, W. Sir Charles Wakefield will preside, and the lecture, which will be illustrated by lantern slides from photographs taken during the flight, will commence at 8.30 p.m

LIGHT 'PLANE CLUB DOINGS

London Aeroplane Club

THE total flying for the week was 23 hrs. 15 mins. The following members had flying instruction :—L. J. C. Mitchell, O. J. Barros, Sir John Rhodes, Mrs. Atkey, G. Wallcousins, E. D. Moss, W. Hay, A. Lees, R. P. Cooper, Miss O'Brien, S. W. Bradshaw, A. Southgate, H. Kennedy, R. C. Presland, L. G. Anderson, R. Malcolm.

The following members made solo flights :—Major K. M. Beaumont, Mrs. Eliott-Lynn, P. G. Lucas, N. Jones. D. Kittell on his own D.H. "Moth" was flying both Saturday and Sunday.

Mrs. Eliott-Lynn and N. Jones flew to Yeovil on Saturday on a D.H. "Moth" recently taken over by two members from the De Havilland Co.

The following subscriptions have been received towards the purchase of a third D.H. "Moth" :—D. Watt, £5 ; D. Foulerton, £3 ; Miss Horsman, £2 ; H. Solomon, £2 ; subscriptions already published, £678. Total to date, £690.

Capt. F. G. M. Sparks, the senior instructor, is laid up with acute b onchitis and pleurisy and will be away from duty for at least a fortnight.

The flying time of the London Aeroplane Club has now exceeded 500 hours.

The Lancashire Aero Cluo'

GEBLV AND GEBMQ were in use up to Saturday, on which day a broken piston ring put MQ out of action, this machine being replaced by GEBLR. Flying has been possible on all days except Monday and Friday.

Mr. Stack gave instruction to :—C. Agar, 3 hrs. 20 mins. ; R. Wade, 3 hrs. 15 mins. ; B. Smith, 2 hrs. 20 mins. ; S. Gattrell, 1 hr. 35 mins. ; A. Goodyear, 1 hr. 30 mins. ; A. Barnes, 1 hr. 20 mins. ; R. Turner, 1 hr. 5 mins. ; L. Slater, 50 mins. ; A. Macnair, 30 mins. ; C. Brown, 30 mins. ; R. Colley, 30 mins. ; D. Turmers, 25 mins. ; J. Leeming, 25 mins. ; A. Leigh, 15 mins. ; M. Lacayo, 10 mins.

Mr. Cantrill instructed :—C. Brown, 1 hr. 10 mins. ; A. Goodye ar, 35 mins. J. Leeming, 30 mins.

Mr. Scholes instructed :—R. Williams, 55 mins. ; J. Leeming, 45 mins. ; P. Michelson, 35 mins. ; S. Crabtree, 35 mins.

Solo flights by :—A. Goodfellow, 30 mins. ; M. Lacayo, 40 mins.

Joy rides :—Miss D. Shirea, 10 mins.

Tests occupied 1 hr. 35 mins. Total dual, 23 hrs. 5 mins. Total solo, 1 hr. 10 mins. Total time flown, 26 hours.

Members are asked to note that the aerodrome is closed ea ch Monday, which is the staff day of rest. Joy rides can be given to members only.

The Newcastle-upon-Tyne Aero Club, Ltd.

REPORT for week ending March 21, 1926 :—Slightly improved weather conditions enabled a considerably larger amount of flying to be carried out during the week than has been possible for some time.

The club is still hampered in having only one machine on service, however, and, of course, one instructor. All previous records, using one machine, were passed on Sunday, when 8 hrs. 15 mins. was flown.

The total for the week was 29 hrs. 15 mins., made up as follows :—

With Major Packman : Dual instruction, 15 hrs. 20 mins. ; secondary dual, 4 hrs. 5 mins. ; passenger flights, 3 hrs. 45 mins.

"A" pilots flying with passengers, 5 hrs. 45 mins. Engine test, 20 minutes (overhauled engine).

The following members had instruction :—Mrs. Marcks, Miss Leathart, Messrs. George, Somerville, Twine, Irving, Leete, W. Todd, Bainbridge, Campbell, Miesagaes, Whitfield, C. Thompson, L. Smith, Sandilands, Bruce. Secondary dual : Messrs. Stobie, Heppell, Thompson, Irving, Thompson, Miss Leathart. "A" pilots who flew : Messrs. Stobie, Heppell, R. N. Thompson, N. S. Todd, W. Baxter Ellis.

The Club was visited by the President, Colonel Sir Joseph Reed, on Sunday morning and was taken for a flight of one hour by Mr. Ellis. After about half-an-hour Mr. Ellis landed near Warkworth to inquire as to whether Sir Joseph was enjoying himself. Each had a cigarette and then proceeded on the return journey to the aerodrome, Sir Joseph stating that he had thoroughly enjoyed the trip.

Other passengers during the week flew with Major Packman as under :—Capt. Roberts, Mr. Stewart, Mr. Alderson, Mr. Deuchar, Mrs. Robson Mr. Robson, Miss Crowther, Miss Wilkie, Miss Fail, Mrs. Ratcliffe.

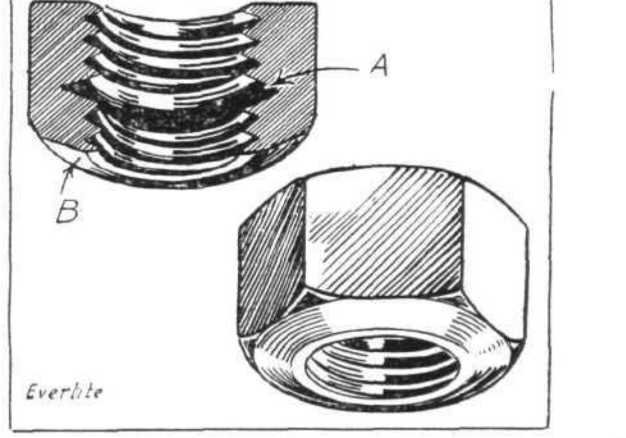
THE "EVERTITE" LOCKNUT

IN no other branch of engineering is the problem of locking nuts securely so important as it is in aeronautical engineering, for the danger arising from nuts working loose on aircraft are obvious.

A simple but effective device has recently been put on the market by British Evertite Locknuts, Ltd., of 22, Bridge Street, Manchester, which, it is claimed, will do much to eliminate this risk, and its very low cost and simple operation should ensure its universal adoption.

Externally the "Evertite" locknut closely resembles an ordinary nut, as may be observed from the accompanying sketch, but it has a bevelled end B, and an annular V-cut groove A within the nut. The action of the "Evertite" is as follows : When screwed home with the bevelled end in contact with the resisting surface, the reaction causes the groove to yield. Thus, a slight but sufficient distortion of the thread then results, thereby effecting a positive, or direct, lock upon the bolt, which functions repeatedly without injury to the thread of either nut or bolt.

"Evertite" locknuts are made in all standard sizes. In place of the present indirect method of obtaining security by the use of either double nuts, a nut and spring washer, or a castle nut with split pins, the "Evertite" can safely be employed as a direct and self-contained locknut in every branch of engineering.



THE "EVERTITE" LOCK-NUT : When screwed home with the bevelled end B in contact with the resisting surface, the reaction causes the groove A to yield, causing a slight distortion of the thread and consequent positive lock upon the bolt.

CIVIL MARINE AIRCRAFT: Some of the machines referred to by Mr. Simmonds. **(See pp. 181, 182.)**

DETAILS OF CIVIL MARINE AIRCRAFT. Supplement to Mr. O. E. Simmonds' Paper. (See pp. 180 and 182)

Table 1. Main Particulars

	Flying Boats													*Float Seaplanes*			
Type	Air Yacht	H150	Viking IV	21.Hm. T.6	Vulture	Sea Eagle	Wal	Swan	33C	H190	F3	R.O. III	Delphin	14 T2	Goliath	Arkona	Jasmund
Constructor	Loening	Lioré et Olivier	Vickers	Schreck	Vickers	Super-marine	Dornier	Super-marine	C.A.M.S.	Lioré et Olivier	Short	Rohr-bach	Dornier	Breguet	Farman	L.F.G.	L.F.G.
Monoplane or biplane	Mono.	Bl.	Bl.	Bl.	Bl.	Bl.	Mono.	Bl.	Bl.	Bl.	Bl.	Mono.	Mono.	Bl.	Bl.	Mono.	Mono.
Approximate date of construction	1921	1925	1921	1925	1924	1922	1922	1924	1922	1925	1920	1925	1921	1920	1922	1922	1922
Materials of construction...	Com-posite	Wood	Wood	Wood	Wood	Wood	Metal	Wood	Wood	Wood	Wood	Metal	Metal	Metal	Wood	Metal	Metal
Engines, No. and type	1 Liberty	3 Jupiter	1 Napier	1 Lorraine	1 Napier	1 Napier	2 Rolls-Royce	2 Napier	2 Hispano	1 Jupiter	2 Rolls-Royce	2 Rolls-Royce	1 B.M.W.	1 Renault	2 Jupiter	1 B.M.W.	1 B.M.W.
Total normal horse-power	400	1200	440	450	440	440	730	880	550	400	700	730	240	300	800	185	185
Wing area ... ... sq. ft.	385	1470	635	575	828	620	1120	1272	995	692	1430	785	550	549	1732	388	430
Normal Accommodation—																	
Crew	1	2	1	2	1	1	2	2	2	2	2	3	2	1	2	2	2
Passengers	4	12	6	4	6	7	11	10	4	6	8	12	5	3	12	4	4
Power loading, lbs. per H.P.	10·15	12·2	13·62	14·3	14·78	14·78	15·4	15·6	16·46	17·1	18·18	18·7	22·5	14·33	16·0	21·97	23·24
Wing loading, lbs. per sq. ft.	10·55	9·95	9·45	11·2	7·85	10·5	10·0	10·78	9·1	9·9	8·98	17·4	9·8	7·84	7·4	10·48	10·0
Maximum speed (sea level) m.p.h.	135	112	111	118	105	99	115	105	120	102·5	95	124	100	105	105	105	105
Crusing speed (sea level) m.p.h.	115	93	90	100	85	84	97	87	100	87	75	112	78	90	87	87	87
Rate of climb (sea level) ft. per min.	1000	560	765	657	555	540	470	510	475	320	500	600	390	483	510	410	450
Landing speed (sea level) m.p.h.	52	56	52·5	59·5	48	56	53	58	56	56	51	68	52·5	48	47	56	56
Kl. max (deduced)	·765	·624	·67	·615	·67	·659	·70	·63	·57	·615	·678	·74	·70	·67	·655	·655	·627
Speed range ... ... m.p.h.	83	56	58·5	58·5	57	43	62	47	64	46·5	44	56	47·5	57	58	49	49

Table 2. Component Weights. (Lbs.)

Type	Air Yacht	H.150	Viking IV	21 Hm. T6	Vulture	Sea Eagle	Wal	Swan	33C	H190	F3	R.O. III	Delphin	14T2	Goliath	Arkona	Jasmund
Weight fully loaded	4059	14650	6000	6445	6500	6500	11250	13710	9050	6840	12700	13670	5400	4300	12800	4060	4300
Power plant	920	2646	1394	1302	1415	1284	2410	2600	2100	992	2921	2480	965	1148	1786	750	750
Fuel oil and tanks...	550	1941	695	849	703	864	1075	1640	1499	719	1253	996	457	497	1292	571	552
Structure	1400	5450	2208	2275	2571	2546	4748	5439	3310	2560	5404	5300	2401	1652	5780	1675	1720
Accommodation	153	225	72	143	100	150	330	435	110	134	160	600	242	90	331	88	132
Disposable load	1036	4388	1631	1876	1711	1656	2687	3596	2031	2435	2962	4294	1335	913	3611	976	1146
Crew	180	360	180	180	180	180	360	360	180	180	360	360	180	180	360	180	180
Equipment...	195	513	175	213	175	235	305	254	420	437	315	260	290	220	288	218	218
Paying load	661	3515	1276	1483	1356	1241	2022	2982	1431	1818	2287	3674	865	513	2963	578	748
Variation in paying load per 100 miles... ...	172	650	215	283	215	280	340	538	500	234	418	302	145	166	432	185	185

Table 3.—Component Weights. (Lbs. per H.P.)

Type	Air Yacht	H150	Viking IV.	21 Hm. T6	Vulture	Sea Eagle	Wal	Swan	33C.	H190	F3.	R.O. III.	Delphin	14T2.	Goliath	Arkona	Jasmund
Fully Loaded	10·15	12·2	13·63	14·3	14·78	14·78	15·4	15·6	16·46	17·1	18·18	18·7	22·5	14·33	16·0	21·97	23·24
Power Plant	2·30	2·21	3·16	2·90	3·22	2·92	3·30	2·96	3·82	2·48	4·18	3·40	4·01	3·82	2·23	4·05	4·05
Fuel, Oil and Tanks	1·38	1·62	1·58	1·89	1·60	1·96	1·47	1·87	2·72	1·80	1·79	1·37	1·90	1·66	1·62	3·09	2·99
Structure	3·50	4·54	5·02	5·05	5·84	5·80	6·50	6·18	6·02	6·40	7·74	7·25	10·02	5·51	7·24	9·06	9·30
Accommodation	0·38	0·18	0·16	0·32	0·23	0·34	0·45	0·50	0·20	0·33	0·23	0·81	1·01	0·30	0·41	0·48	0·71
Disposable Load	2·59	3·65	3·71	4·17	3·89	3·76	3·68	4·09	3·70	6·09	4·24	5·87	5·56	3·04	4·50	5·29	6·19
Crew	0·45	0·30	0·41	0·40	0·41	0·41	0·49	0·41	0·33	0·45	0·52	0·49	0·75	0·60	0·45	0·97	0·97
Equipment	0·49	0·43	0·40	0·47	0·40	0·53	0·42	0·29	0·76	1·09	0·45	0·36	1·21	0·73	0·35	1·18	1·18
Paying Load	1·65	2·92	2·90	3·30	3·08	2·82	2·77	3·39	2·61	4·55	3·27	5·02	3·60	1·71	3·70	3·14	4·04
Variation in Paying Load per 100 miles ...	0·43	0·54	0·49	0·63	0·49	0·64	0·47	0·61	0·91	0·59	0·60	0·41	0·61	0·55	0·54	1·0	1·0
Accommodation per Passenger lbs.	38·2	18·75	12·0	36·7	16·6	21·4	30·0	43·5	27·5	22·3	20·0	50·0	48·4	30·0	27·6	22·0	33·0

Table 4.—Component Weights. (Per Cent. of Total Weight.)

Type	Air Yacht	H150	Viking IV.	21 Hm. T6.	Vulture	Sea Eagle.	Wal	Swan	33C.	H190	F3.	R.O.III.	Delphin	14T2.	Goliath	Arkona	Jasmund
Power Plant	22·6	18·1	23·2	20·2	21·8	19·7	21·4	19·0	23·2	14·5	23·0	18·1	17·8	26·7	13·9	18·5	17·4
Fuel, Oil and Tanks	13·6	13·3	11·6	13·2	10·8	13·3	9·6	12·0	16·6	10·5	9·9	7·3	8·5	11·6	10·1	14·0	12·8
Structure	34·5	37·2	36·8	35·4	39·6	39·2	42·2	39·6	36·6	37·4	42·5	38·8	44·5	38·4	45·1	41·2	40·0
Accommodation	3·8	1·5	1·2	2·1	1·5	2·3	2·9	3·2	1·2	2·0	1·3	4·4	4·5	2·1	2·6	2·2	3·1
Disposable Load	25·5	29·9	27·2	29·1	26·3	25·5	23·9	26·2	22·4	35·6	23·3	31·4	24·7	21·2	28·3	24·1	26·7
Crew	4·4	2·5	3·0	2·8	2·8	2·8	3·2	2·6	2·0	2·6	2·8	2·6	3·3	4·2	2·8	4·4	4·2
Equipment	4·8	3·4	2·9	3·3	2·7	3·6	2·7	1·9	4·6	6·4	2·5	1·9	5·4	5·1	2·3	5·4	5·1
Paying Load	16·3	24·0	21·3	23·0	20·8	19·1	18·0	21·7	15·8	26·6	18·0	26·9	16·0	11·9	23·2	14·3	17·4
Variation in Paying Load per 100 Miles ...	4·2	4·4	3·6	4·4	3·3	4·3	3·2	3·9	5·5	3·4	3·3	2·2	2·7	3·9	3·4	4·6	4·3

DEVELOPMENT OF CIVIL MARINE AIRCRAFT

Some unusually interesting data collected by Mr. O. E. Simmonds

THE paper read by Mr. O. E. Simmonds before the Institution of Aeronautical Engineers on March 9, under the title " The Development of Civil Marine Aircraft," proved an unusually interesting one. The paper was rather long, and does not lend itself to being summarised, but a lot of very valuable information was contained in a series of tables, which we reproduce on p. 181. For the first time comparative figures for a number of seaplanes have been made available, and in order to appreciate what the tables actually mean, we quote below the lecturer's explanatory remarks :—

(1) The machines are arranged in order of power loading.

(2) As the aim of the tables is to compare designs, hull soakage is not included in the structure weight of wooden machines.

(3) Machines built as amphibians have had all amphibian gear removed in computing structure weight in order to obtain more accurate comparisons.

(4) All figures are calculated on the basis of a 300-mile flight at cruising speed, and the effect on paying load of each additional 100 miles is indicated.

(5) Disposable load includes crew, equipment and paying load—not fuel.

(6) Table I indicates the maximum number of crew and passengers for which provision is made. In other tables, aircraft of less than 10,000 lb. gross weight are assumed to require one pilot only; above that weight allowance is made for a second member of the crew.

(7) It will be noted that considerable disparity exists between the weight of accommodation and equipment for the various machines. As in some instances items naturally falling under these headings may be fixtures and thus become included in structure weight, no attempt has been made to reduce the weights under these two headings to a standard figure. All machines carry wireless equipment, flying instruments and marine gear, although the weights of these items vary considerably.

(8) In Tables III and IV the complete list of component weights is given in terms of normal horse-power and as percentages of total weight respectively. By this means comparisons of enhanced value are obtainable, since inefficient components of each machine can readily be seen and their bearing on the final index figures gauged.

By way of assisting in forming an idea of the various types of machines in question, we give, on p. 180, photographs of 14 out of the 16 machines dealt with by the lecturer. Although the photographs are small, they should illustrate such points as must be kept in mind in making comparisons, the more so as all the machines will be fairly familiar to readers of FLIGHT, practically all the machines having previously been described and illustrated in FLIGHT at some time or other.

As regards the paper itself, it may be said to have tended to demonstrate that the seaplane, regarded as a commercial vehicle, is not anything like as inferior to the landplane in the matter of load carried per horse-power as many have imagined.

The Polar Flight Expeditions

JUST as everything was ready for a start with the polar flight expedition, led by Capt. G. H. Wilkins, both the aeroplanes to be employed for the purpose of exploring the unknown arctic regions were damaged during trial flights at Fairbanks, Alaska. As a result, it will be some days before the machines can be repaired and a start for the Pole made.

Meanwhile successful trials are being continued with the Amundsen-Ellsworth polar airship " Norge " at Rome, while it is reported from New York that Commander Richard E. Byrd has obtained leave from the U.S. Navy to attempt a flight to the North Pole. He proposes to use a Fokker machine and to start from Spitzbergen.

Pussyfoot Claws at Croydon

ONE of the items—and a much-needed one—of the improved London Terminal Aerodrome at Croydon that had been planned by the Air Ministry was the erection of a big modern hotel, worthy of what was hoped would be Europe's most important of airports. The Croydon Borough Justices, however, have decided otherwise—although not unanimously—for when an application for a licence for the hotel was made by the contractors, backed by the Air Ministry, it was refused. It is difficult to understand the reason for such an outrage against public convenience, an action which makes London official methods the laughing stock of Europe.

South of England Aeroplane Club

WE have received the following announcement respecting the above Club :—The South of England Aeroplane Club, which has been formed under the patronage of Sir Frederic Wise, M.P., and others, expects to commence operations at Brooklands aerodrome in the course of next month, using Avro 504K and D.H. " Moth " machines. A large number of applications for membership have been received, but there are still immediate vacancies. Those who wish to learn to fly during the coming summer should lose no time in getting in touch with this Club. Particulars of the club and its activities can be obtained by sending a stamped envelope to the Secretary, Flying Officer W. Knox, at 21, Airlie Gardens, Ilford, Essex. We understand that it is intended that this club should embrace the whole of the south of England, and not Essex only, as originally intended. Application has been made to the Air Ministry for inclusion in the Light Plane Club scheme.

The Danish Flight to Tokyo

THE two Danish pilots, Lieuts. Botved and Herschend, who left Copenhagen on March 16 in an attempt to fly to Tokyo in two " Junkers " aeroplanes, proceeding from Berlin which was reached the same afternoon, they reached Constantinople a few days later. Lieut. Herschend got to Aleppo on March 21, but lost sight of his companion *en route*. Lieut. Botved, however, had to descend at Eski Shehr (Asia Minor) in foggy weather, but rejoined his companion later at Aleppo.

Coupet's New Record

LIEUT. LUCIEN COUPET, flying a Breguet XIX fitted with a 500 h.p. Farman engine at Villacoublay on March 17, established a new world's altitude record for a machine carrying a load of 1,000 kgs., when he attained an altitude of 6,450 m. (21,158 ft.).

Commercial Air Lines in South America

THE first Bolivian air traffic line is a weekly service running between Cochabamba and Santa Cruz ; it is operated with all-metal Junkers-type F.13 aeroplanes, and in the first three months 385 passengers have been carried. This interesting airway development is all the more striking in that it is actually the highest altitude airway in the world, Santa Cruz being 987 ft. above sea level, whilst Cochabamba is at an altitude of no less than 12,000 ft. above sea level and is the world's highest air port.

Reports received from Buenos Aires state that the Junkers Mission in South America intends operating a passenger air line between Buenos Ayres and Montevideo, which is to be flown three times a week. The manager of the Junkers Mission travelled by a Junkers seaplane to Montevideo for the purpose of entering into negotiations with the Postmaster-General of Uruguay. It is hoped that as a result of these discussions the new route will be opened shortly.

Over Siberian Plains by Air

UNDER the pilotage of M. Balyscheff a Russian-built Junkers aeroplane belonging to the " Dobroljot " recently flew from Moscow to Krasnojarsk. The machine was *en route* for Turuchansk and carried mails and passengers destined for several villages in the North Siberian Plains. It is a survey flight, undertaken for the purpose of studying the possibilities for opening an air express service for the benefit of fur traders.

The Rolls-Royce Condor Series III

A DESCRIPTIVE handbook on the Series III Rolls Royce " Condor " aero engine has just been issued by the Air Ministry (Air Publication 1158). Copies can be obtained from H.M. Stationery Office, Kingsway, W.C.2, the price being 4s. net. The book, which is remarkably well illustrated by photographs and sketches, is divided into 3 parts ; Part I being a description of the engine, Part II instructions for dismantling and assembling, and Part III directions for running and maintenance of the engine.

THE ROYAL AIR FORCE

London Gazette, March 16, 1926.

General Duties Branch.

The following Pilot officers are promoted to rank of Flying Officers :— J. F. Young (Dec. 15, 1925) ; D. A. Boyle (Jan. 31) ; L. S. Birt (Feb. 15). Flight Lieut. S. E. Adams is placed on retired list on account of ill-health and is granted permission to retain rank of Squadron Leader (March 17) ; Observer Officer W. J. Harris is placed on retired list (March 14) ; Flight Lieut. J. H. Bentham is transferred to Reserve, Class A (March 14) ; Flying Officer R. F. de R. Read relinquishes his short service commn. on account of ill-health (March 17).

Stores Branch.

The following Pilot Officers on probation are confirmed in rank (Feb. 10) :— P. P. S. Rickard, L. Taylor, J. E. Welman.

Medical Branch.

G. S. Strachan, M.B., is granted a short service commn. as Flying Officer for three years on active list, with effect from and with seniority of March 1 ; Group Capt. N. J. Roche O.B.E., is placed on retired list at his own request (from half-pay) (March 1).

Reserve of Air Force Officers.

C. V. Hicks is granted a commission in Class A, General Duties Branch as a Pilot Officer on probation (March 16). The following are confirmed in rank :—Flying Officer F. W. Marshall (March 8) ; Pilot Officer A. B. Roche (Feb. 4). Flying Officer E. Bradley is transferred from Class A to Class C (March 3) ; the commission of Pilot Officer on probation W. J. Overy is terminated on cessation of duty (Feb. 26).

ROYAL AIR FORCE INTELLIGENCE

Appointments.—The following appointments in the Royal Air Force are notified :—

General Duties Branch

Wing Commander V. Gaskell-Blackburn, D.S.C., A.F.C., to No. 9 Sqdn., Manston, to command ; 28.2.26.

Squadron-Leader H. H. MacL. Fraser, to Aircraft Park, India ; 5.2.26.

Flight-Lieutenant R. Grice, D.F.C., to No. 1 Flying Training Sch., Netheravon ; 22.3.26.

Flying Officers : A. T. K. Shipwright, D.F.C., to Armament and Gunnery Sch., Eastchurch ; 16.3.26. C. H. A. Stevens, to No. 6 Sqdn., Iraq ; 27.2.26.

Pilot Officers : W. I. N. Strong, to No. 5 Flying Training Sch., Sealand, on appointment to a Permanent Commn. (on probation) ; 13.3.26. The under-mentioned Pilot Officers are all posted to No. 5 Flying Training Sch., Sealand, on appointment to Short Service Commns. (on probation), with effect from 13.3.26 :—G. E. W. Bankes-Williams, R. A. Barnett, B. J. Bushe-Caryesford, G. Carleton, J. Constable-Roberts, J. W. Duggan, I. J. Fitch, R. S. Fleming, E. C. Foreman, J. H. Harris, H. P. Hudson, R. J. Legg, A. A. Leslie, N. McLeod, R. R. Nash, R. G. Pace, E. J. Pentland, N. C. Pleasance, N. C. R. Roberts, G. H. Shaw, S. R. Sherman, M. A. Smyth, L. R. Stokes, G. A. V. Tyson, E. F. Wain.

Stores Branch

Wing Commander F. H. Kirby, V.C., O.B.E., D.C.M., to No. 4 Stores Depot, Ruislip, to command ; 16.3.26.

Flying Officer V. B. Ranford, to R.A.F. Training Base, Leuchars ; 22.3.26.

Accountant Branch

Flying Officer J. J. T. Rose, to H.Q., Egypt ; 1.3.26.

Medical Branch

Wing Commander J. MacGregor, M.C., M.D., to H.Q., Iraq, for duty as Principal Med. Officer ; 5.3.26.

Flight-Lieutenants : P. C. Livingstone, B.A., F.R.C.S. (E), D.P.H., D.O.M. and S. to Res. Lab. and Med. Officers' Sch. of Instruction, Hampstead ; 18.3.26. C. P. Barber, to Station Commandant, Basrah ; 31.1.26.

Flight-Lieutenant (Quartermaster Medical) J. M. Maxwell, to Basrah Combined Hospital ; 5.3.26.

Flying Officers : C. J. MacQuillan, M.B., B.A., to Station Commandant, Basrah ; 6.2.26. L. C. Palmer-Jones, M.B., to H.Q., Iraq ; 5.3.26. G. M. Anderson, M.B., to No. 5 Flying Training Sch., Sealand ; 14.3.26.

Gordon Shephard Memorial Prize Essay Awards

The Gordon Shephard Memorial prizes, which are given annually for the best essays submitted by members of the Royal Air Force on subjects selected by the Air Council, have been awarded as follows in the 1925 competition :—

First prize : Flight-Lieut. V. H. Tait, Directorate of Organisation and Staff Duties (Signals branch), Air Ministry.

Second prize : Sqdn.-Ldr. F. J. Linnell, O.B.E., Headquarters, Air Defences of Great Britain.

Third prize : Sqdn.-Ldr. L. L. Maclean, P.S.A., Directorate of Organisation and Staff Duties, Air Ministry.

The competition was established as a memorial to the late Brig.-Gen. G. S. Shephard, D.S.O., M.C., R.A.F.

IN PARLIAMENT

Royal Air Force Pilots and Discharges

LIEUT.-COMMANDER KENWORTHY, on March 15, asked the Secretary of State for Air how many officer pilots and airmen pilots, respectively, are being discharged from the Air Service between now and the end of the present year ; how many of these are leaving at the expiration of their engagements, and how many are leaving for other causes ?

Major Sir Philip Sassoon : As all our estimates of personal requirements are based on the financial year, I should prefer, if the hon. and gallant Member agrees, to give figures for the financial rather than the calendar year. The number of officer pilots due to pass from the active list of the Royal Air Force in the financial year 1926 is 257, nearly all being short-service officers who will pass into the Reserve ; and the number of airmen pilots due for transfer to the Reserve is five. It is not possible to forecast the number who may cease to be employed for other reasons, but it will be small.

Lieut.-Commander Kenworthy : Does that mean that there are no reductions being made, and that there is only the ordinary normal passing to Reserve ?

Sir P. Sassoon : The hon. and gallant gentleman asked me how many officers are being discharged.

Lieut.-Commander Kenworthy : May I put it in another way ? Are any pilots being "axed" out of the service ? I do not mean those whose engagements have expired. Are any reductions being made apart from that ?

Sir P. Sassoon : No, Sir.

Aircraft Reserves

CAPTAIN CROOKSHANK, on March 17, asked the Secretary of State for Air how many aeroplanes there are in commission and in reserve in the Royal Air Force ?

Sir P. Sassoon : The present first line strength of aircraft in regular squadrons of the Royal Air Force is 658 machines. In addition, the existing auxiliary and special reserve squadrons have an establishment of 58 first line machines. It would not be in the public interest to state the number of aircraft in reserve.

Captain Crookshank : Are we right in assuming that the information that we have not more than 2,424 is still correct ?

Sir P. Sassoon : I believe that some figure did appear, but I am afraid that I cannot give any more information than I have.

The Armistice and American-built Aeroplanes

CAPTAIN GUNSTON asked the Secretary of State for Air the number of American-built aeroplanes flying over the Allied lines on the date of the Armistice ?

Sir P. Sassoon : I have no official information upon this subject, but I am informed that in a book by an American author who had access to official records it is stated that 10 of the American squadrons (of 18 machines each), at the front were equipped with American-built machines on November 1, 1918.

Private Civil Flying

COLONEL DAY asked the Secretary of State for Air whether any action is contemplated with a view to greater freedom being afforded to those who desire to use their own aeroplanes for purposes of experimental tests, business, or pleasure ; and whether the Royal Aeronautical Society and the Air League will be asked for their opinions as to a greater measure of freedom from official interference ?

Sir P. Sassoon : The question of the possible relaxation of some of the existing regulations governing private civil flying has been the subject of discussion with representatives of the Royal Aeronautical Society, the Air League and other aeronautical bodies, and the views expressed are now being most carefully considered by the Air Ministry.

Disarmament : Germany

SIR F. HALL asked the Prime Minister what powers of control are still retained by the Allies with regard to disarmament and naval, military and aircraft development on the part of Germany ; and what machinery exists for exercising those powers ?

The Prime Minister : The Aeronautical Commission of Control, having completed its work, was, in agreement with the German Government, replaced in 1922 by a Committee of Guarantee, whose task is to ensure that aeronautical development in Germany does not infringe the provisions of the Treaty of Versailles. Negotiations are now in progress with a view to withdrawing the Committee as soon as Germany's obligations in regard to future aeronautical development have been defined in agreement between the ex-Allied Governments and Germany.

Sir F. Hall : May I ask whether the Government consider it necessary or advisable to exercise control over the future development of the aircraft policy of Germany ?

The Prime Minister : I think that is provided for in Article 203.

Empire Air Communications

SIR H. BRITTAIN asked whether, following the successful flights which have been and are being made from North to South Africa, and vice versa, it is the intention of his Department to develop further aviation in that continent ; and, if so, whether he can give the House any outline of future plans ?

Sir P. Sassoon : I am obliged to my hon. Friend for raising this question. As I stated when introducing the Air Estimates, I am most anxious to further by all possible means the development of Empire air communications. Something has already been done in this direction in Africa. Proposals are under consideration for the establishment of an air service from Khartum to Kisumu and I understand that a recent conference of Colonial Governors at Nairobi approved in principle the granting of financial assistance for an experimental service on this route. The question of the establishment of a regular service, with an extension in due course to Cairo, will depend upon the result of the experiment and the prospects of adequate financial support. The development of aviation in the Union of South Africa and Southern Rhodesia is, of course, primarily a matter for the Governments concerned, but I propose to take the opportunity afforded by the Imperial Conference next October to discuss with the Dominion representatives the question of Imperial air routes and their future development.

SOCIETY OF MODEL AERONAUTICAL ENGINEERS

A MEETING of the Society took place at Headquarters on Wednesday, March 17. It proved to be a distintly interesting one, both on account of the paper read and of the exhibits shown. The paper on "Rubber Motors" read by Mr. R. Langley gave an account of a considerable amount of experimental work carried out in this connection and was much appreciated. The results obtained, chiefly shown graphically, should prove of high value in future. A full account of this will be given in due course in the S.M.A.E. Journal.

Among the numerous examples of recent model work exhibited during the evening, the following are very worthy of note :—

(1) Mr. R. N. Bullock's new speed model (fuselage type).
(2) A fuselage speed model by Mr. J. O. Mortlock. Both of these models were of exceptionally good design and workmanship.
(3) Two sets of gears for rubber motors by Mr. H. T. Jackson.
(4) An ingenious new form of twin-winder with counting attachment by Mr. C. A. Rippon.

The following are the rules for the 1926 speed competition :

Speed Competition—1926.

(*To be held on Saturday, June* 19. *Ground to be decided later.*)

(1) Models for this competition must be fuselage models with a lifting surface not exceeding one square foot in area.
 (N.B.—The fuselage must comply with the S.M.A.E. rule governing same.)
(2) The models will be required to fly over a "timed course," the timing to be done by a method approved by the Council.
(3) The length of the course shall be 150 ft. ; the starting and finishing lines each to be located by two posts, whose separation at right angles to the course is 100 ft. A tape will be stretched across the starting line at a few inches from the ground in order to ensure the model passing this line in flight.
(4) Models shall be started "rising off ground."
(5) In the event of two or more competitor's times being within $\frac{2}{5}$ seconds of each other, a further trial shall be run to finally decide their times.
(6) The competition is open to non-members on payment of a fee of 2*s*. 6*d*.

1st prize.—The S.M.A.E. Cup and £1 1*s*. cash.

The rules for the other new competition, namely for Autogiro models, will appear at a later date.

Final arrangements were made (at the meeting) for the visit to Halton Aerodrome, where a model flying display is to be given by the Society on Saturday, March 27.

B. K. JOHNSON, *Secretary S.M.A.E*

D. Napier and Son, Ltd.

THE directors, in issuing the balance sheet of the company as at September 30, 1925, report a profit on the year's trading, including interest on investments (after providing for depreciation, interest, taxation, directors' and trustees' fees, managers' commissions and contingencies) amounting to £237,542 8*s*. 10*d*. Add balance brought forward, £39,729 7*s*. 10*d*, making £277,271 16*s*. 8*d*. Deduct dividend paid on preference shares at 7½ per cent. per annum (less income tax) for the 12 months ended June 30, 1925, £22,500 ; interim dividend of 5 per cent. (less income tax) paid on ordinary shares on September 18, 1925, £27,300 ; amount transferred to general reserve, £100,000, leaving £127,471 16*s*. 8*d*. The directors recommend a final dividend of 10 per cent. on the ordinary shares, making in all 15 per cent. for the year, leaving a balance to carry forward of £72,871 16*s*. 8*d*. The directors add that the further improved results testify to the fact that the outstanding merits of Napier aero engines have been fully appreciated both at home and abroad.

A 16-ft. Metal Airscrew

WHAT is claimed to be the largest metal air-screw yet constructed, a two-bladed propeller of stainless steel, has just been completed for the Air Ministry by Metal Propellers, Ltd., of Purley-way, Croydon. It is over 16 ft. in diameter, and is the first of a batch to be employed for the new Government rigid airship R.101. It is of the reversible type, a mechanism being provided in the hub whereby the angle of the blades may be varied.

SIDE WIND

OFFICERS of the Royal Air Force will be interested to know that they are being very thoroughly catered for by the famous firm of Burch's in the Strand. We have this week received one of their New Price Lists and we note that they are still making a profound study of officers' R.A.F. Outfits by supplying the whole issue, not only Service Dress, but Boots and Hosiery and other equipment needed for an officer, and furthermore they are supplying New Commissioned Officers with their whole Outfit pending their Grant. We think this is indeed an exceptional offer and a boon to all those taking up the R.A.F. as a career. It is obvious that the reputation of this House is the result of thought, care and hard work—these three are embodied in every R.A.F. garment which is produced and sent out by them. That this service is appreciated to its fullest extent is evidenced by the wide circle of officers who are patronising them from almost every aerodrome both at home and abroad.

PUBLICATIONS RECEIVED

Canadian Patent Office Record. February 23 *and March* 2, 1926. *Vol. LIV, Nos.* 8 *and* 9. The Canadian Patent Office, Ottawa, Canada.

The Gloster. March-April, 1926. *No.* 6. The Gloucestershire Aircraft Co., Ltd., Sunningend Works, Cheltenham, Glos.

The Meteorological Observer's Handbook. 1926 *Edition.* The Meteorological Office, Air Ministry. H.M. Stationery Office, Kingsway, London, W.C. 2. Price 5*s*. net.

The Official Gazette of the United States Patent Office. March 2, 1926. *Vol.* 344, *No.* 1. United States Patent Office, Washington, D.C., U.S.A.

Notiziario Tecnico. No. 1. *January*, 1926. Direzione della Rivista Aeronautica, Via Torino, 39, Rome.

Il Volo Transpolare. By Col. Ing. Umberto Nobile. Stabilimento di Costruzioni Aeronautiche, Rome.

Civil Aviation : A Report by the Joint Committee on Civil Aviation of the U.S. Department of Commerce and the American Engineering Council. McGraw-Hill Publishing Co., Ltd., 6–8, Bouverie Street, London, E.C. 4. Price 12*s*. 6*d*. net.

Cambridge University Engineering and Aeronautical Societies' Journal. Vol. I, No. 1. W. Heffer and Sons, Cambridge.

AERONAUTICAL PATENT SPECIFICATIONS

Abbreviations : Cyl. = cylinder ; i.c. = internal combustion : m. = motor. The numbers in brackets are those under which the Specifications will be printed and abridged, etc.

APPLIED FOR IN 1924

Published March 25, 1926.

27,910. J. H. LARRARD. Aircraft framework. (248,051.)
28,330. R. S. CHEESMAN. Dirigible flying-machine of helicopter type. (248,065.)
28,600. F. L. RAPSON. Tyres, wheels, etc., for use on aeroplanes. (248,086.)
28,665. SUPERMARINE AVIATION WORKS, LTD., and R. J. MITCHELL. Flying boats, etc. (248,088.)
28.697. G. H. DOWTY and GLOUCESTERSHIRE AIRCRAFT CO., LTD. Landing-devices for aircraft. (248,090.)
29,197. ARMSTRONG SIDDELEY MOTORS, LTD., and F. R. SMITH. Internal expanding brakes and clutches. (248,106.)

APPLIED FOR IN 1925

Published March 25, 1926.

1,631. G. RIETTI. Flying-machines. (227,866.)
4,296. BAYERISCHE MOTOREN WERKE AKT.-GES. Carburettor for aircraft engines. (230,043.)

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